

JUNE
1948

IN THIS ISSUE:
Removing Phenols
From Water
Highway Subgrade
Soil Practices
Small Sewage
Treatment

Public Works Magazine

OHIO STATE
UNIVERSITY
JUN 6 1948

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A PURE WATER SUPPLY!

CAMPAIGN promises are rarely kept, but election year . . . and every year . . . you can count on pure, safe water if you choose a %Proportioneers% Heavy Duty Midget Chlor-O-Feeder to hypochlorinate your water supply. This small proportioning pump treats from a few gallons up to a million gallons of water a day,



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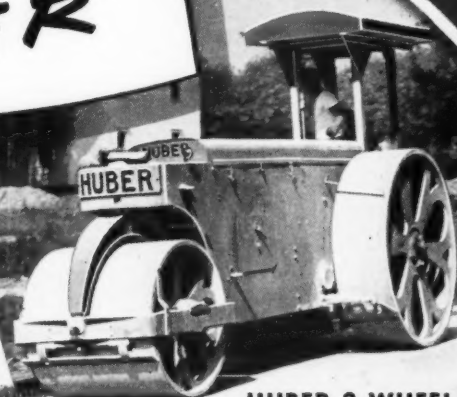
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**HOW TO MAKE YOUR
BUDGET DOLLAR GO
FARTHER**



HUBER MAINTAINER

A versatile machine that also serves as a bulldozer, lift-loader, patch roller, snow-plow, or rotary broom.



HUBER 3-WHEEL ROLLERS

Automotive type, built in sizes from 5 to 12 tons. A fast, economical and powerful machine.



HUBER TANDEM ROLLERS

Variable weight offering maximum maneuverability. Built in sizes from 3 to 12 tons.

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THE



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**ROAD ROLLERS
and
MAINTAINERS**

**When Trouble-Free, Low-Maintenance, Clog-
Proof Pumping of Sewage is Needed,
Flush-Kleens are Specified**

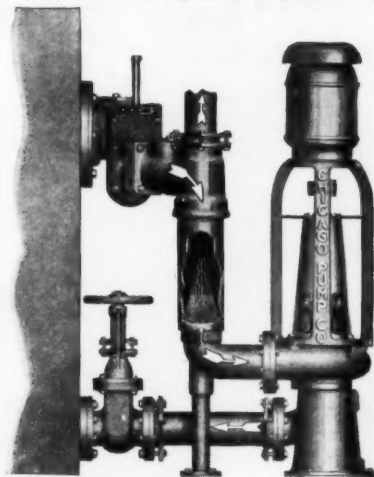
Because-

**'They Cannot Clog as Solids
Do Not Pass the Impeller**

"Flush-Kleen" pumps provide automatic, trouble-free service in sewage lift-stations. They require no manual attention except periodic lubrication and inspection and no labor is required for disassembling and cleaning clogged pumps as with other types.

Another factor which greatly reduces maintenance requirements is that "Flush-Kleens" have less of a wear factor than other pumps. This is due to the fact that the impellers handle only strained sewage. No solids pass through the impeller to cause excessive strain and wear on impeller, shaft, bearings or motor; pumps remain in balance and operate economically with little attention.

"Flush-Kleens" operate alternately

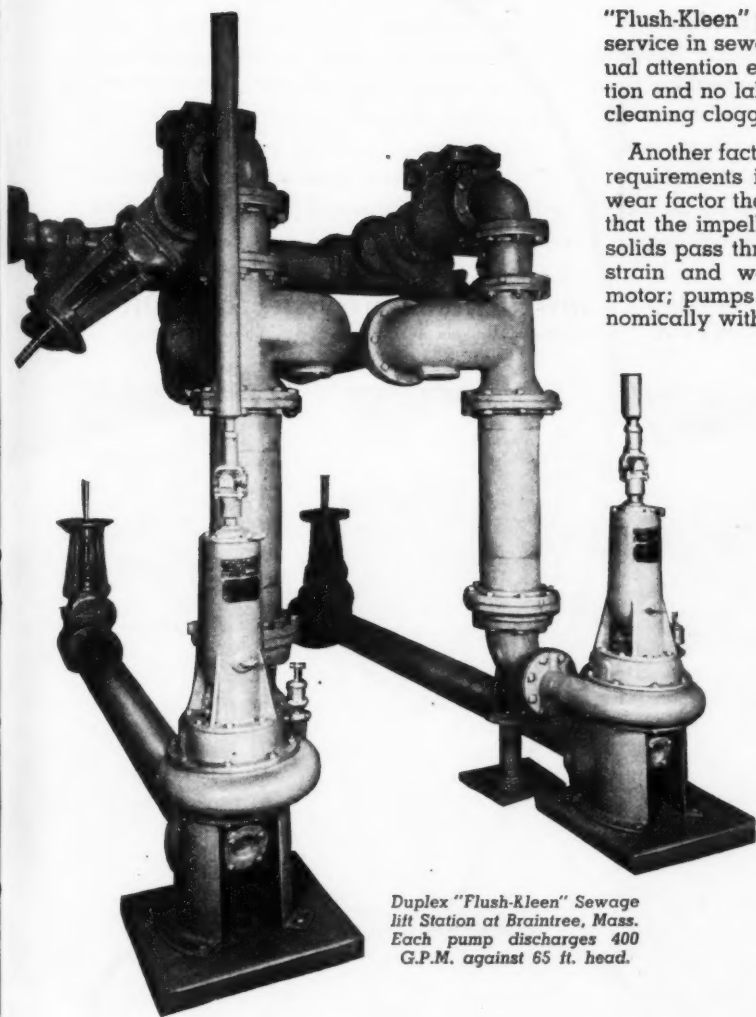


Filling Wet Well

- Sewage flows through inlet pipe.
- Coarse matter is retained on strainer.
- Strained sewage flows through idle pump to wet well.

Pumping

- Strained sewage is pumped from wet well.
- Coarse matter is backwashed from strainer.
- Special check valve closes; sewage and coarse matter are pumped to sewers.



Duplex "Flush-Kleen" Sewage lift Station at Braintree, Mass. Each pump discharges 400 G.P.M. against 65 ft. head.

CHICAGO PUMP COMPANY
SEWAGE EQUIPMENT DIVISION

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Flush-Kleen, Scrub-Peller, Plunger,
Horizontal and Vertical Non-Clogs,
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At this greatest of all road shows you'll see International leading the power parade in the earthmoving and roadbuilding industry!

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SOLDIER FIELD
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JULY 16-24, 1948

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CRAWLER TRACTORS • WHEEL TRACTORS DIESEL ENGINES • POWER UNITS

When you need special information—consult the READERS' SERVICE DEPT. on pages 81-84

PUBLIC WORKS Magazine

Founded in 1896

Vol. 79, No. 6

W. A. HARDENBERGH and A. PRESCOTT FOLWELL
Editors

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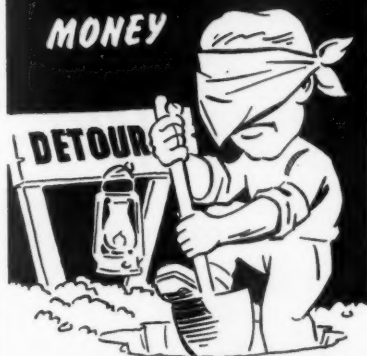
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wastes TIME and
MONEY



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bends, dead ends,
service stubs, and traces the exact
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lines up to 12 feet deep, with pin-
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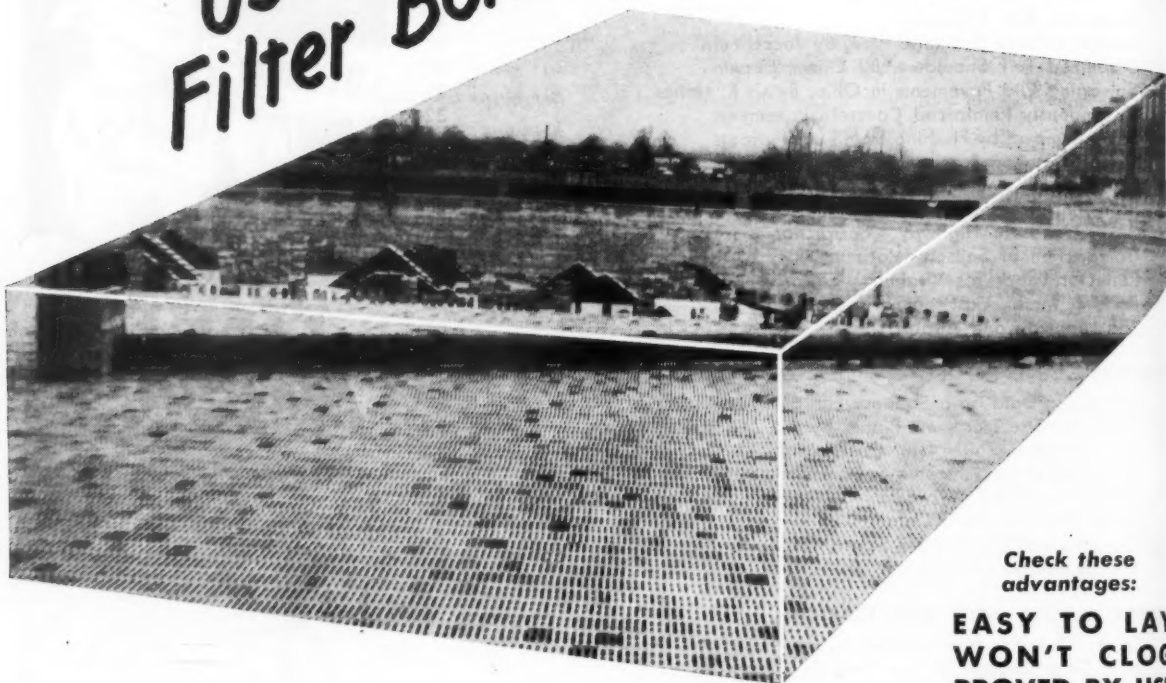
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describes M-
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many of its
profitable
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**EASY TO LAY
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The Editor's Page

Don't Miss the 1948 Road Show Next Month

Many engineers will join with us in a hearty welcome to the Road Show. It is nice to have it back with us again after an absence of several years. Yet that absence may give us the perspective from which we can view more competently its accomplishments in years gone by. Our own belief is that it has been one of the, if not *the*, outstanding influence for better roads. It has done this not only by putting on a good "show" in the matter of equipment, but also by really top-notch work with highway engineers.

At the Road Show will be shown the newest and best of post-war roadbuilding equipment. We learned many lessons during the war and these are now being made available to the industry through improved equipment, more powerful, adaptable to a wider range of work, and able to do the job either at a lower cost or with less dependence on manpower. We are learning slowly that mechanization is essential for building and maintaining our highway system. We will learn much from what will be on exhibit there.

The Road Show has always been a spectacle that has been good for lots of publicity. It has helped to weld together the many groups whose primary objects have been more roads and better roads. But we believe that the technical sessions and the work done by outstanding highway engineers in developing and standardizing better construction methods, better equipment and better materials have been of even greater value to the industry than has been the publicity and education that, nevertheless, has been so necessary.

Behind all of this has been Charles M. Upham, and he has done a fine job. The 1948 Road Show will help to solve the problems of building more roads with the money now available, of maintaining those we now have, and of producing more satisfactory and travelable streets and highways—vitaly needed by this country for both peace and war. As such, no one can afford to miss it.

Trying to Get Engineers

A survey by the AASHO shows that only 511 of the 2883 civil engineers being graduated this spring from 116 leading engineering schools are interested in entering highway work. Highway departments have been short of engineers for a long time, and the same is true of most every other governmental organization utilizing engineers. In part, this is due to the reduction in engineering graduates during the war, from which recovery cannot be expected in full for several years yet. In part it is due to the fact that engineers have not been considered as worthy of fair pay as the lawyers and doctors employed by these same governmental organizations. Industry, which has been quicker to appreciate the values that engineers can contribute, and more flexible in its pay schedules, has not been so seriously hit. It is of interest to note that the Public Health Service, which is about the only governmental organization that gives

even a tolerably fair deal to sanitary engineers, has recently issued an attractive booklet describing the advantages of a career with that organization.

The engineer is a professional man and is entitled to consideration on that basis, and to pay and opportunities equal to those of other professional men. When these facts are fully realized, the opportunities for engineers in government should improve.

Increasing Suburban Population Brings Many Problems

"Instead of the familiar pattern of rural development and an occasional improved subdivision," states the Board of County Road Commissioners of Wayne County, Mich., in its 1947 report, "there now exist communities of extensive character, consisting of street after street on which homes have been built on almost every lot. A start toward providing public improvements, such as water supply and sewerage, has been made in some instances through the combined efforts of the townships and of the sewer and water departments of this Board. . . . The chief problem, however, that affects maintenance of roads and streets is that of storm water drainage. As development of the county areas progresses, this problem becomes aggravated. Practically every land improvement that occurs increases the run-off to the rivers and streams or restricts their channels. Areas that formerly absorbed a considerable amount of overflow in times of high water have been eliminated and are now contributing additional loads to the streams. . . . It is believed that the only permanent solution to this problem is the establishment of an adequate storm water sewer system. It is realized that this will be an enormous undertaking and cannot be accomplished quickly; but it is evident that a start will have to be made before long which will lead to relief of a more constructive and permanent nature than the cleaning and deepening of ditches."

Phooie!

An editor, we suppose, should be patient, gentle and hurt no feelings. Maybe so; but once in a while, despite our good intent, editorial feelings do get ruffled. Of late, it seems, we have had an increasing number of letters on very minor matters which are signed "by direction of." In the army, the good old "by command of" may be necessary or desirable, because there is a definite chain of command and responsibility; and anyway, the army has always operated that way, and it's about hopeless to get them to change old-time practices. But in civilian affairs, such methods do not seem to have any place. Good administration consists of providing such leadership that everyone in the organization works toward the common goal, utilizing their individual abilities within the general framework of the program. It seems to us, though we may be wrong, that an unusual proportion of these letters come from health departments. Anyway, phooie on the practice; it's childish and shows an inferiority complex.



COMING SOON..

...TO RESTAURANTS, HOTELS, GROCERY STORES, ETC., IN YOUR TOWN...

Before long the flies will be coming to restaurants, hotels, grocery stores and every place in your town to open refuse where they can feed and breed. They'll stay and multiply . . . spreading contamination and disease.

To meet this threat, many sanitation minded cities have installed the Dempster-Dumpster System of detachable truck bodies handled by a single truck. Bodies are placed throughout the business district, factory areas, schools, housing areas . . . in fact, wherever bulk trash or refuse accumulates. Once rubbish is placed in the body and the door is closed, no flies or rats can contaminate it . . . no wind or domestic animal can scatter it . . . fire hazard is completely eliminated. As the bodies are filled, a truck hoisting unit makes scheduled collection rounds, picks up each loaded body in turn, hauls it . . . dumps it and returns the empty to its original position. It's as quick and simple as that . . . only one man, the driver, handles the entire collection operation with the hydraulic hoisting unit.

In addition, the Dempster-Dumpster System guarantees tremendous savings in operational expenses. Remember that one truck hoisting unit with several bodies does the work of 4 or 5 conventional trucks.

SHOWN AT RIGHT: Hoisting unit with 10 cu. yd. body, preparatory to pick-up operation. Center: Body in carrying position. Bottom: Body in dumping position. Note how drop-bottom forms chute to guide trash.

DEMPSTER DUMPSTER

TRADE MARK REG.

DEMPSTER BROTHERS, Inc., 968 Dempster Bldg., Knoxville 17, Tennessee

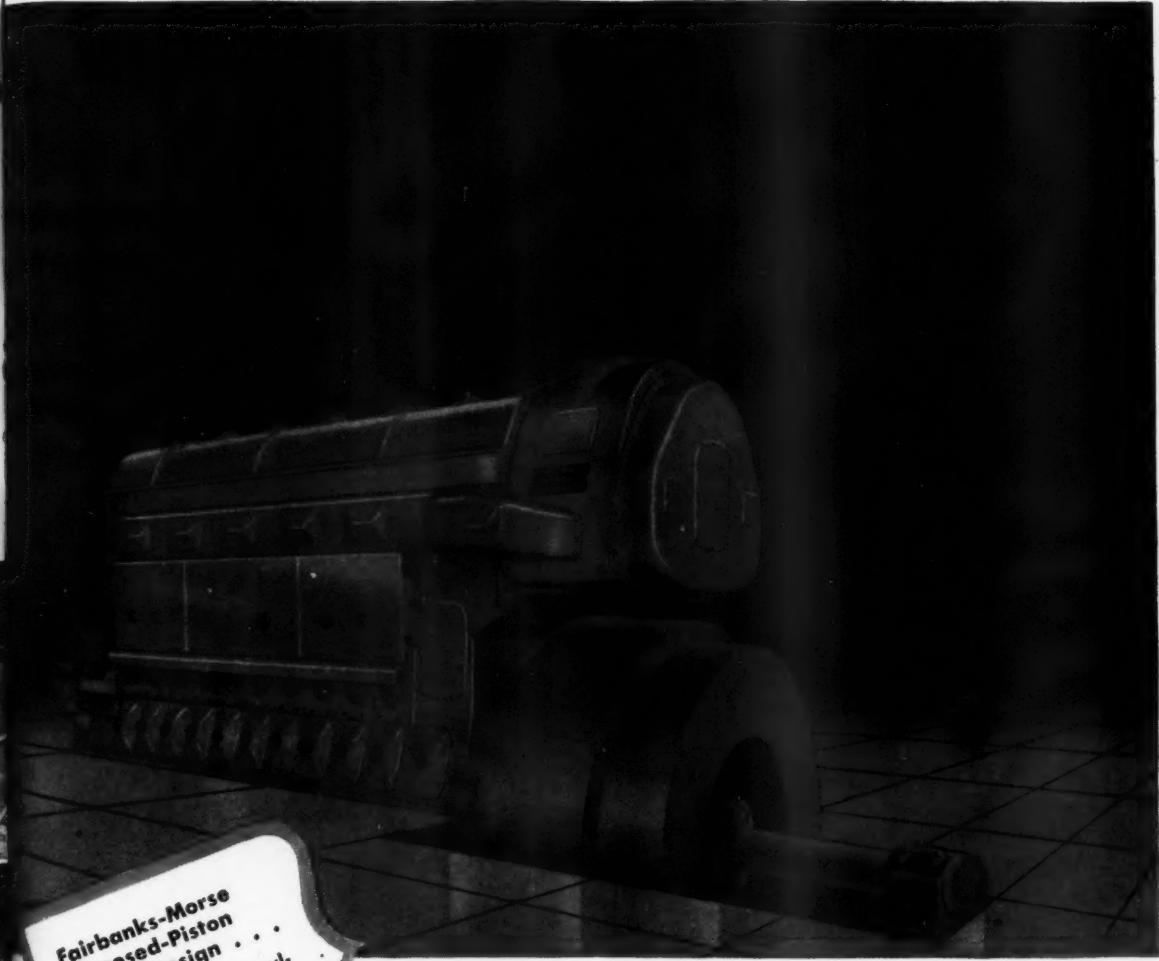
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1..



Tennessee



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Opposed-Piston
Diesel Design . . .**

Two pistons in each cylinder, driven apart by a central combustion . . . delivering more power per cylinder, reducing bulk and weight, minimizing maintenance costs and "down time." Proved for years in toughest heavy-duty service.

For Diesel Engines . . .



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A name worth remembering

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Outstanding . . .

The Fairbanks-Morse Model 38 Opposed-Piston Engine!

The Model 38's advanced two-cycle Opposed-Piston design eliminates 40 percent of the working parts of the ordinary Diesel engine. The Model 38 has no valves, no cylinder heads —produces up to twice as much horsepower per foot of floor space! For heavy-duty service as the main engine in small plants or a space-saving unit in larger installations, consider the basic advantages of the Model 38. See your Fairbanks-Morse Diesel specialist for full particulars . . .

Fairbanks, Morse & Co., Chicago 5, Ill.

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PUMPS • FARM EQUIPMENT • MAGNETOS
RAILROAD MOTOR CARS and STANDPIPES

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WITH PERMANENT, SAFE CLAY PIPE INSTALLATIONS



EVER since Mrs. O'Leary's cow kicked up the big fuss back in 1871, Chicago has been *growing*. From a population of less than 300,000 on the date of that terrible disaster, the famous Windy City has marched along to a hefty 3,500,000.

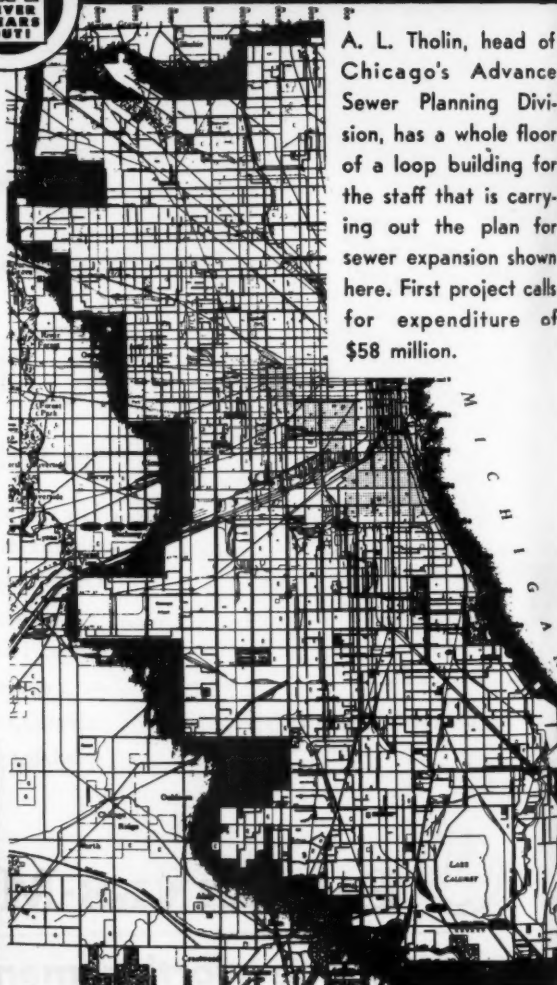
Vitrified Clay Pipe has played an important role in this past expansion, and in hundreds of current developments. For engineers know that Vitrified Clay Pipe is the only sewerage and drainage pipe impervious to the action of corrosive materials, acids, ground and sewage alkalis. *In all the history of Chicago's building, there has never been a single instance where Clay Pipe has worn out!* If you need specific information on Clay Pipe, write the details to the office nearest you.

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1105 Huntington Bank Building, Columbus 15, Ohio
111 W. Washington Street, Chicago 2, Illinois
703 Ninth and Hill Bldg., Los Angeles 15, California



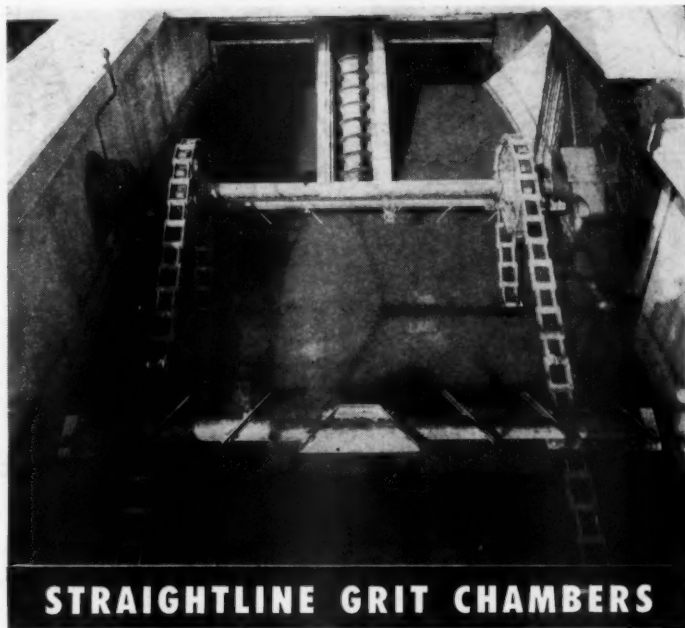
C-348-1



A. L. Tholin, head of Chicago's Advance Sewer Planning Division, has a whole floor of a loop building for the staff that is carrying out the plan for sewer expansion shown here. First project calls for expenditure of \$58 million.

Is GRIT REMOVAL Your Problem?

Why let grit plug your pipe lines, wear out your pumps and take up valuable space in your digester? Get in touch with our nearest branch office, and let our sanitary equipment engineers help you solve your problem. They are in a position to outline a method and recommend the right type of equipment — for instance:



STRAIGHTLINE GRIT CHAMBERS

For the removal of a clean, washed grit with a low putrescible content. The collecting and thorough cleaning operation makes further handling unnecessary.



TRITOR SCREENS

For the removal of screenings and grit at small sewage treatment plants where grit creates a problem during storm flows. With the Tritor Screen, one mechanism accomplishes removal of both grit and screenings. A grinder may be used to shred the screenings when no grit is received, and during storms, the grinder may be by-passed and grit and screenings disposed of by fill, burial or incineration.

In addition to grit handling and washing equipment, Link-Belt Company manufactures a complete line of equipment for water, sewage and industrial waste treatment such as Straightline and Circuline sludge collectors, screens, mixers, scum breakers, aerators, dryers, power transmitting, elevating and conveying machinery. Send for catalogs.

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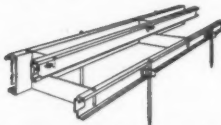
SCREENS · COLLECTORS · MIXERS · AERATORS

"QUIT WORRYING ABOUT SPECIFICATIONS"



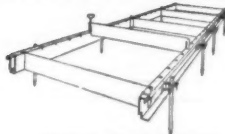
CURB FORMS

Sections 10' long—either straight or battered face construction. Steel forms for all special concrete curbs.



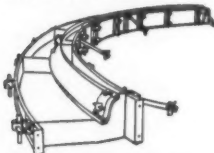
COMBINED CURB AND GUTTER FORMS

Each 10' section consists of 1 back curb form, 1 front gutter form and 1 face curb form, also 2 face curb form supports, 2 round stakes for back form and 2 round stakes for gutter form.



HELTZEL SIDEWALK FORMS

10' sections, slotted every 12" for division plates, which are removed without disturbing side forms after concrete takes its initial set.



HELTZEL RIGID RADIUS FORMS

For building concrete curbs or gutters when all intersections or corners must match. Heltzel forms made in sets to form a specified radius.



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Used when building radius curbs, curbs and gutters or sidewalks where the radius is subject to frequent change or for serpentine work in park areas.

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Send me the following:

☐ B-19 Steel Highway and Airport Forms

☐ B-19A Steel Dual Duty Airport Forms

☐ A-20 Steel Forms for Curbs or Curb and Gutters or Sidewalks.

Name _____

Address _____

City _____

State _____

(Type of construction usually engaged in)

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BUILDS IT BETTER

BINS, Portable and Stationary
CEMENT BINS, Portable and Stationary

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BATCHERS (for batch trucks or truck mixers with automatic dial or beam scale)

ROAD FORMS (with lip curb and integral curb attachments)

CURB FORMS

CURB AND GUTTER FORMS

SIDEWALK FORMS

CONCRETE BUCKETS

TOOL BOXES

FINISHING TOOLS FOR CONCRETE ROADS

FROM OUR READERS

EXTRA COPIES:

The Editor.—Please send us six copies of the April, 1948, issues of *Public Works*. In addition, we would like to have six reprints of the article "Small Sewage Treatment Plants" which appeared in the February, March, and April issues.

COLORADO MUNICIPAL LEAGUE

WATER FOR AIR CONDITIONING:

The Editor.—We are interested in the use of water for air conditioning and would like more information regarding the survey you reported in April *Public Works*.

Did Alhambra, Calif., or any other city that required the return of cooling water to the distribution system, make any provisions or restrictions to cover the installations and methods of returning the used water to the system? What provisions were made to insure freedom from contamination of the potable water in the distribution system?

Where cooling water is returned to the underground storage after its use in air conditioning, as at Freeport, L. I., what provisions and restrictions are provided as to the depth of discharge, manner of discharge of used water, cross connections, etc.? As a general rule, do you think this is good practice?

To what extent from the returns, would you say that the cities in southeastern U. S. are taking steps to restrict the use of potable water in air conditioning?

A SANITARY ENGINEER

[Ed. Note: Neither Alhambra, or any other city, required the return of used air conditioning water to the distribution system—only reuse of the water, presumably for further air conditioning. However, there seems to be no objection to its use for showers, flushing toilets, lavatories, etc., provided adequate insurance is provided that it is either excluded from the distribution system or is so protected or treated as to be potable.]

The return of used water to the ground water in Long Island is done under the regulations of the New York State Water Power and Con-

trol Commission, which has issued specific regulations covering the manner of discharge.

It is felt that adequate steps are not being taken in the southeast or in any other part of the country to restrict the use of potable water for air conditioning.]

Water Purification Control

This is a text-book, written by Edward S. Hopkins, and published by Williams & Wilkins Co., Baltimore, Md. It contains 289 pages and numerous illustrations. This is the third edition.

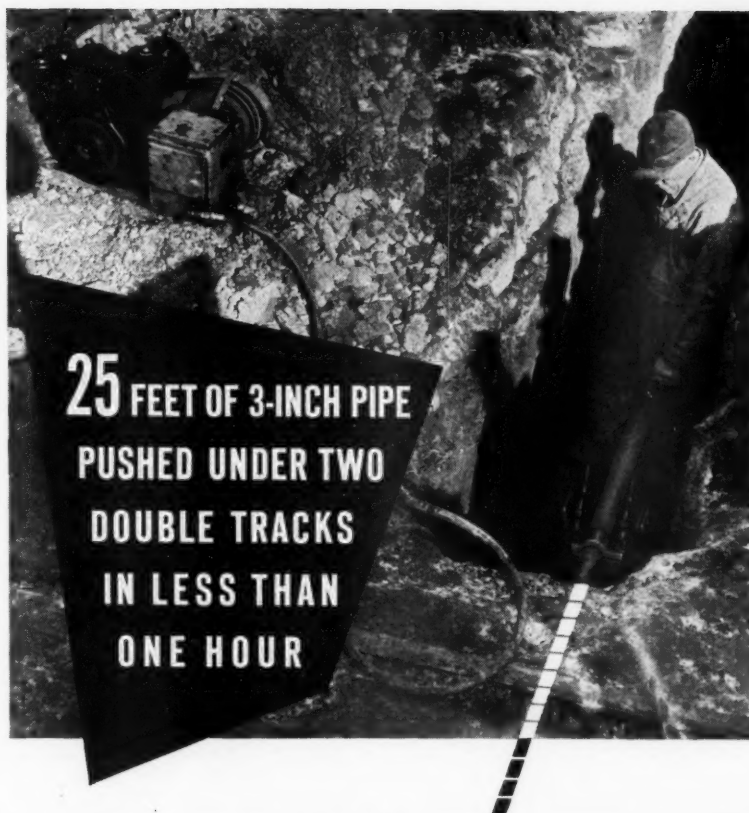
There is one thing above all others that makes this excellent book so valuable; that is the tremendous pains that the author, one of our best known water works engineers, has taken to verify all of the information that he has used. As a result, the student or the engineer can rely to an unusual extent on the statements in the text.

Primarily this is a book for the men responsible for operating our water purification plants, and it is intended to explain for them the objectives of the processes employed. The chapter headings show the scope of the work: Coagulation, color removal, iron and manganese removal, sedimentation, filtration, disinfection, tastes and odors, corrective treatment, and softening.

Within the limits of a review such as this it is impossible to indicate either the volume of information presented, or the extent of its usefulness. Every man engaged in water purification ought to have a copy, and ought to study it. The result would be better water works operation. The author draws on a fine background of experience and training. He has long been associated with the Baltimore water purification plants, and during the war, as a Lt. Col. of the Sanitary Corps, was in charge of sanitary engineering in the entire Third Service Command.

The Blowflies of North America

This is a complete and scholarly text of 476 pages and numerous illustrations devoted to the history, importance to man, control and classification of the blowflies of North America. It was written by David G. Hall of the Bureau of Entomology of the Department of Agriculture, a man who contributed greatly to the control of insect-borne diseases in the Pacific during the war. As an officer of the Sanitary Corps, he had assigned to him a private plane, a DC-3, with which he covered countless thousands of miles of that ocean. We are not competent to judge the value of this book except through our acquaintance with the author; and on the basis of his knowledge and ability, we must rate it very highly, and recommend it to all those who want information on this subject.



...with a GREENLEE HYDRAULIC PIPE PUSHER

"We made this fast, under-railway installation during a near-zero spell," reports Harris-McBurney Co. of Jackson, Michigan. "And without the GREENLEE Pusher and Power Pump we would not have otherwise even attempted the job."

"During the past three years we have used the GREENLEE Pusher to install many thousands of feet of pipe and telephone cable conduit under airport runways, streets, railways, and highways."

"By no means could these jobs have been done as efficiently, quickly, or

at as low cost as with a GREENLEE. Ours paid for itself on the first job."

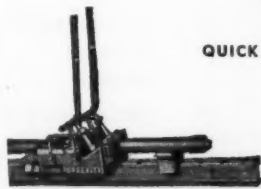
You, too, can make big time and labor savings with a GREENLEE which pushes pipe under obstructions. Eliminates extensive ditching since just a short trench accommodates the Pusher—no tearing up, backfilling, tamping, tunneling, repaving.

Get facts today on this timesaving, efficient tool. Write Greenlee Tool Co., Division of Greenlee Bros. & Co., 2046 Columbia Avenue, Rockford, Illinois, U. S. A.



QUICK FACTS ABOUT THE GREENLEE HYDRAULIC PIPE PUSHER

Easy—one or two men can easily operate on any job.
Portable—compact, easy to carry to job and set up.
Fast—operates at six different speeds. *Two models*—(1) for pipe up to 4-inch; (2) for larger pipe, drainage ducts, concrete sewer pipe. Do the job easier, quicker with a GREENLEE.



When you need special information—consult the READERS' SERVICE DEPT. on pages 81-84

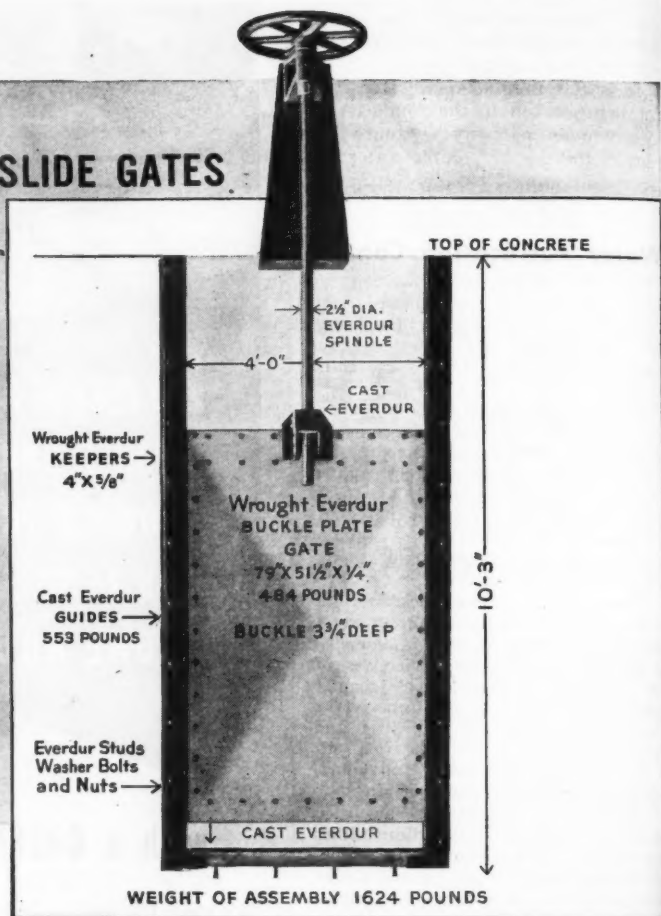
FROM COTTER PINS TO SLIDE GATES

Everdur

STANDS UP

LONGER IN

SEWAGE SERVICE



One of the five 13-year-old shut-off gates of Everdur Metal in the screen room of the Rahway Valley Joint Meeting Sewage Treatment Plant.

FOR 20 years Everdur® Copper-Silicon Alloys have performed well under the corrosive conditions imposed on sewage treatment equipment. These alloys have unusual resistance to corrosion. In addition, they provide high strength and, according to type, may be cast, hot or cold rolled, drawn, spun, forged or welded.

A good example of Everdur advantages is seen in the five shut-off gates in the screen room at Rahway,

N. J., installed more than 13 years ago. These gates, which operate smoothly and easily by hand, weigh 1624 lbs., while cast, electrically-driven gates for the same service would have weighed well over four tons each!

In view of the fact that sewage service must not fail, a cotter pin may be as essential as the most massive equipment. Thus, Everdur Metal has been more and more widely specified for such uses as:

Coarse and Fine Screens
Swing Gates
Built-up Sluice Gates
Bar Rack Aprons
Effluent and Scum Weirs
Scum Baffle Brackets
Troughs
Screen Hoppers
Orifices
Buckets

Anchors
Ladders
Float Gage Chains
Valve Springs
Manhole Steps
Guides
Walkways
Bars and Plates
Bolts and Nuts

For detailed information, write for Publications E-11 and E-5.

*Reg. U. S. Pat. Off.

47198



Everdur

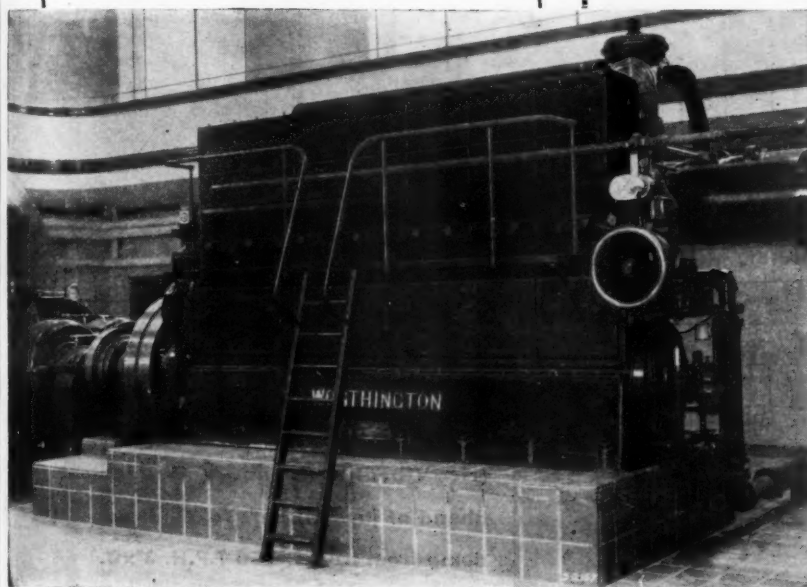
COPPER-SILICON ALLOYS

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

SAVED \$199,000 IN SIX YEARS!

**Worthington Gas Engine
In Fort Wayne's Sewage
Disposal Plant Has
Paid For Itself Many
Times Over**



Worthington Gas Engine—Type CCG-7, 465 hp—in the Sewage Disposal Plant, Fort Wayne, Texas. Besides driving a blower, the unit heats sludge digesters with water from the cooling jacket.

An important factor in Fort Wayne's improved health rate, the city's Sewage Disposal Plant has gained nation-wide recognition for its progressive design and operation.

Heart of the installation is a Worthington Gas Engine, operating on sewage gas. Direct-connected to a blower, the unit is on continuous heavy duty. In 1946, for example, the *daily average* was 14.65 million cubic feet of air pumped into 18.73 million gallons of sewage.

A Real Pay-Off!

Savings earned by this Worthington Gas Engine during its first six years of service have been enormous. The cost of outside electric power to do the same amount of work would have been many

times the engine's original purchase price! In addition, water from the engine's cooling jacket is used to heat the sludge digesters. In 1946 alone, nine billion BTU's were so utilized — the equivalent of 650 tons of coal!

To Cut YOUR Power Costs

Worthington offers a wide range of Engines for sewage plant service — including the famous Dual Fuel Diesels that operate on gas, oil, or gas-and-oil in any ratio. For further information proving *there's more worth in Worthington*, write to Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.

EE-8

WORTHINGTON



**YOUR
PARTNER
IN
POWER
PROGRESS**

WORTHINGTON-BUILT AUXILIARIES

Diesel engines, 150 to 2,640 hp... gas engines, 175 to 2,470 hp... dual fuel engines, 225 to 2,470 hp.



Air King Compressors



Oil Transfer Pumps

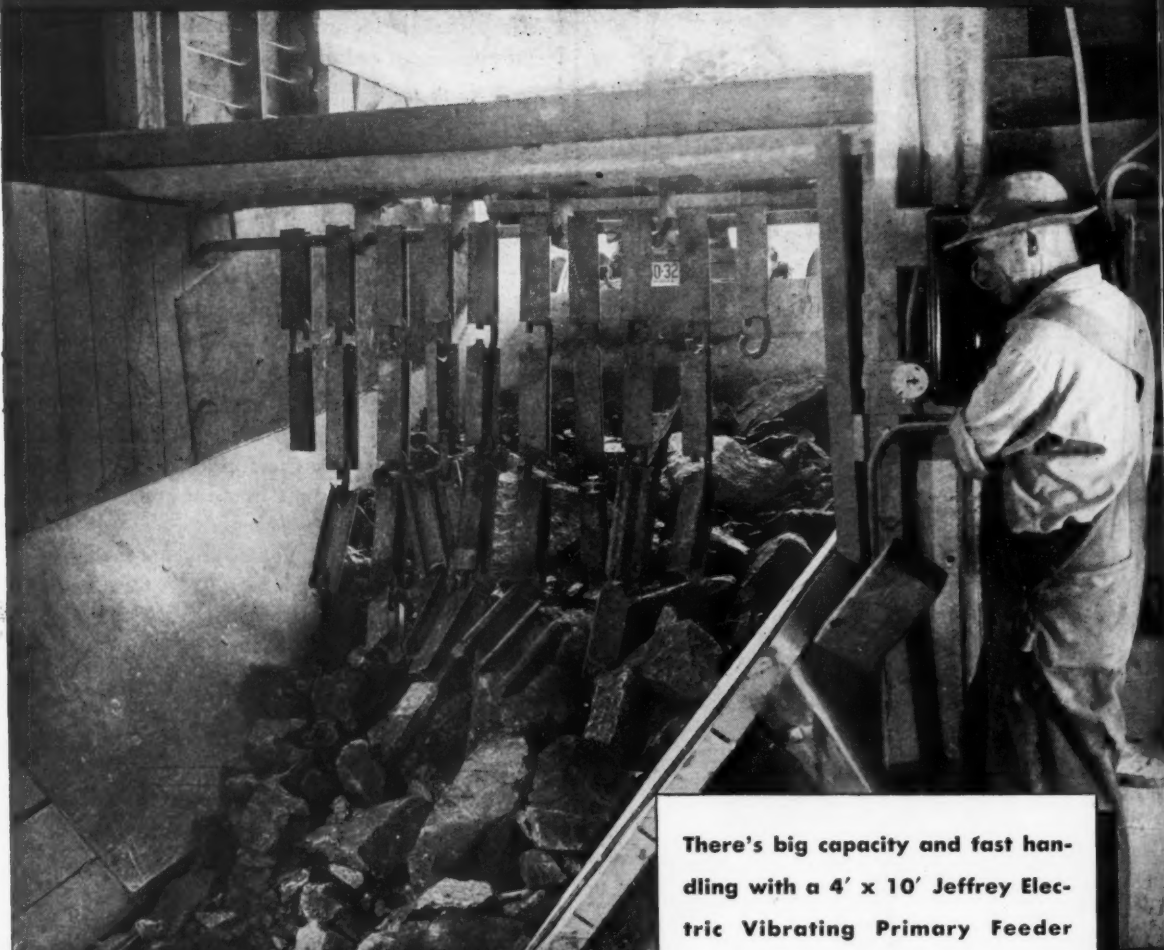


Cooling Water Circulating Pumps



Evaporative Type Engine Water Cooler

TAKES A TRUCKLOAD AT A TIME



There's big capacity and fast handling with a 4' x 10' Jeffrey Electric Vibrating Primary Feeder ahead of jaw crusher. Takes direct dump from trucks. 250 T.P.H. 3'x0.

THE JEFFREY

MANUFACTURING COMPANY

ESTABLISHED 1877

82749 North Tenth St., Columbus 16, Ohio

Jeffrey 1
Columbus 2

Jeffrey 3
Columbus 4

Jeffrey 14
Columbus 5

Jeffrey
Columbus 6

Jeffersonville
New York 7

Pittsburgh 22
St. Louis 8
Salt Lake City 9

Complete Line of
Material Handling,
Processing and
Mining Equipment





*There'll be Bright Lights
in the Old Town Tonight*

**PUSH-BUTTON
DUAL FUEL**

A Superior Feature

**JUST PRESS
A BUTTON**

*to turn your
choice of fuel*



Superior is the first and only Diesel with push-button control of fuel selection that permits you to switch from oil to gas; or gas to oil instantly —with the flick of a finger.

● Yes, tonight and every night an Iowa town will have bright lights that signal a dependable source of electrical power. The power is supplied by a model 80-GX-8 Superior Diesel that develops 1500 hp. at 360 rpm. In addition to supplying the town with electrical power, this Superior produces a surplus which is sold to surrounding farms.

Many communities and industrial plants depend on just one Superior Engine for their entire power supply. This faithful performance is due to the following features offered by these tough engines: Conservative Ratings • Efficient Pressure Lubrication • Clean Combustion • Precision Bearings • Heavy Rigid Crankshafts • Strong Bases and Cylinder Blocks • Proved Roller Chain Camshaft Drives • Oil Cooled Pistons. We will be glad to send you a fully illustrated booklet that tells how these features can help you.

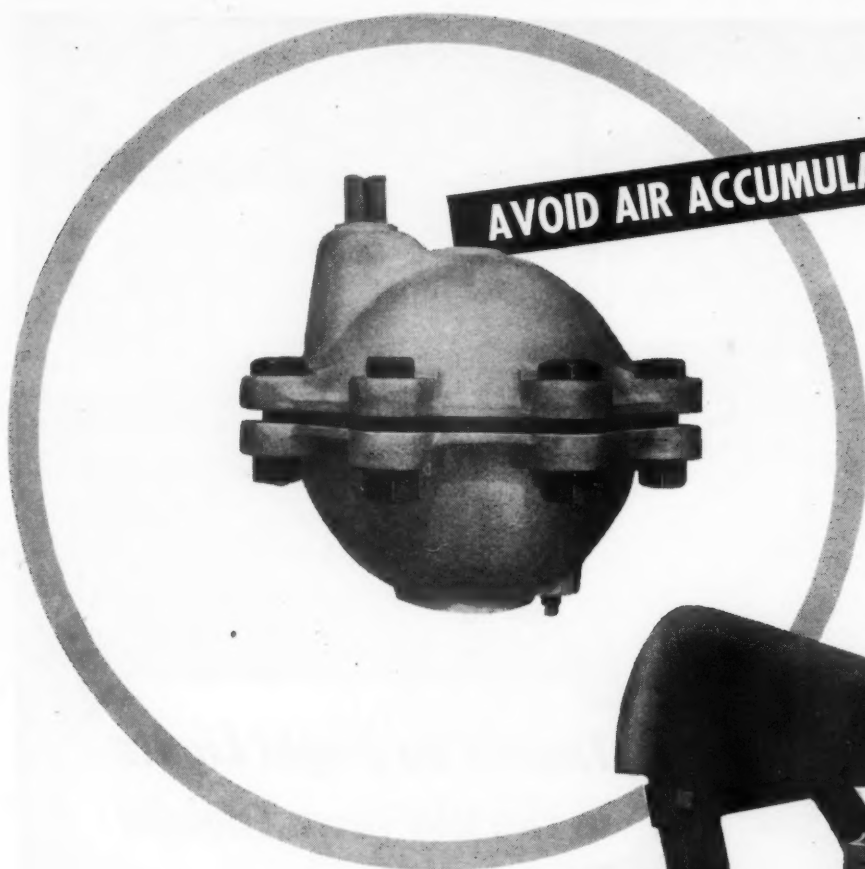


Superior
DIESEL

SUPERIOR ENGINE DIVISION OF
THE NATIONAL SUPPLY COMPANY

**60th
Anniversary**

When writing, we will appreciate your mentioning PUBLIC WORKS



AVOID AIR ACCUMULATIONS IN PIPES!

STOP PIPE COLLAPSE!

Simplex Air Release Valves automatically vent air that accumulates at high points in pipe lines and reduces their carrying capacity. Simplex Air Release Valves are simple and rugged in construction... will open against high internal pressure... and are extremely dependable.

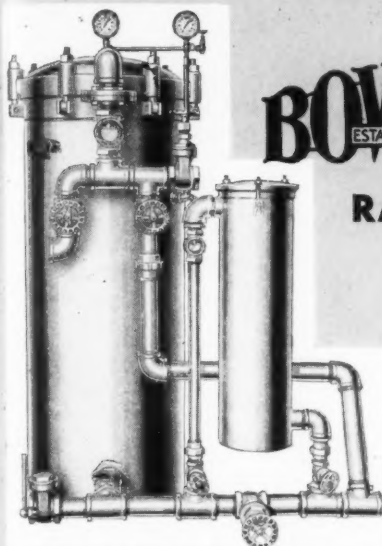
Simplex Air Inlet Valves permit the expulsion of air when lines are being filled, and admit air in large quantities should a break in the line occur. Damage to thin walled pipes caused by release of water and the formation of vacuums at higher points is prevented by the use of Simplex Air Inlet (vacuum breaking) Valves.

For full information and bulletins, write the Simplex Valve & Meter Company, 6750 Upland Street, Philadelphia 42, Pa.



SIMPLEX

VALVE AND METER COMPANY



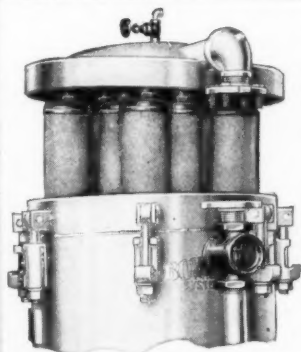
The above illustration of a Bowser Diatomite Filter with Precoat Pot shows the equipment, consisting of piping, valves, flow sights, unions and flanges, which is supplied standard with all sizes to provide easy and simple installation.

BOWSER
ESTABLISHED 1885

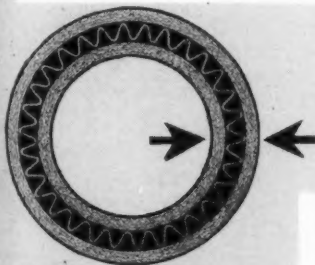
DIATOMITE FILTRATION

RATED BEST BY POOL ENGINEERS ON TEN ESSENTIAL POINTS

1. ELIMINATES COAGULANTS & ALKALI FEEDERS
2. BACKWASHES, DRAINS & PRECOATS IN 10 MINUTES
3. USES ONLY 1/10 USUAL BACKWASH WATER
4. ELIMINATES HIGH CAPACITY BACKWASH PUMPS
5. MONEL ELEMENTS LENGTHEN LIFE
6. USES STANDARD LOW COST FILTER AID
7. OCCUPIES 1/10 TO 1/5 USUAL FLOOR SPACE
8. REQUIRES NO TECHNICAL OPERATORS
9. COSTS LESS TO BUY AND OPERATE
10. FILTERS WATER CLEARER TO EXCEED HIGHEST TEST REQUIREMENTS



Complete accessibility is an important feature of Bowser Filters . . . for by hoisting the cover, to which the filter elements are attached, each element can be quickly detached for complete cleaning or inspection by removing the two tie-rod nuts which hold the complete assembly together.



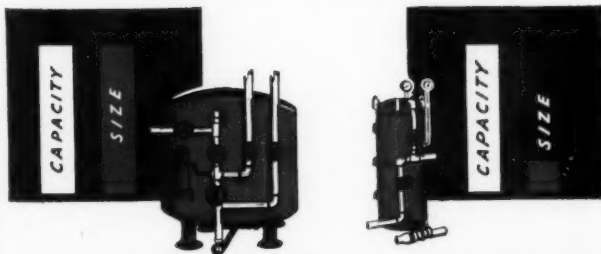
Flow rate is increased almost double . . . and floor space to almost half that possible with single type elements. The unfiltered water flows from inside out . . . and outside in as shown by the arrows . . . the clean water flowing into the $\frac{3}{4}$ " channel and thence to the discharge manifold header.

Bowser Diatomite Filters are popular because they only require from 1/10 to 1/5 the floor space needed by conventional filters to produce an equivalent flow of clean water.

Increase Pool Profits With This Unexcelled Filtering Method

High efficiency of the diatomite agent used enables a Bowser filtration system to produce water of a brilliance and purity not even possible with systems 5 to 10 times its size. Because of this superior performance and compactness, Bowser filters save enough water in backwashing to offset filter aid costs. As operating cost is concentrated mainly in filter aid consumed, a major expense item is automatically eliminated.

Bowser filters are easier to operate, too. Backwashing, draining and precoating can be accomplished in 8 to 10 minutes with simple valve controls. All tanks and parts are thoroughly factory tested to assure trouble-free service and long life.



Write for Complete Story and Data On DIATOMITE FILTRATION

Ask for Bowser's "THE SWIMMING POOL STORY" and "THE MODERN WAY TO FILTER SWIMMING POOL WATER."

You will find in this literature the answer to your most demanding requirements for a better, more profitable pool operation.

BOWSER, INC. FORT WAYNE, IND.

BOWSER

Cut TRACTOR COSTS *one-half* with an **Ottawa Hydraulic Front End Loader**



Tractors used $\frac{1}{2}$ the year cost twice as much to own as tractors used all year 'round.

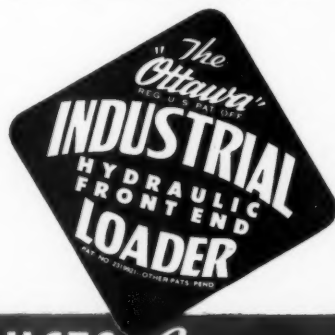
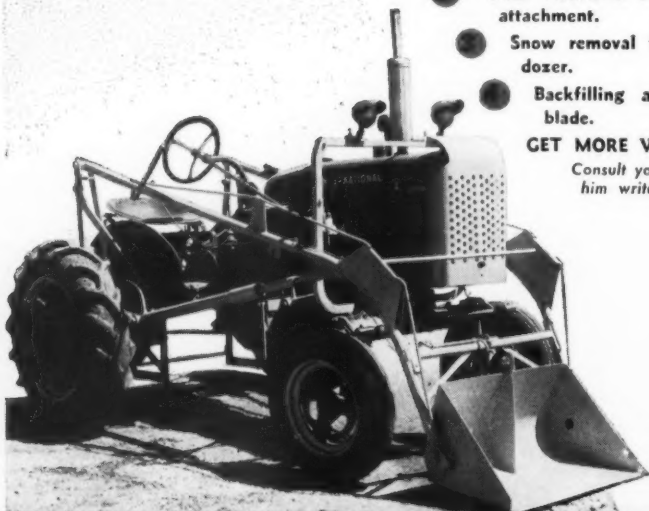
There is an Ottawa loader designed for use with light industrial tractors such as the International A and Case V A I illustrated here. These loaders have been approved by Industrial Engineers of leading tractor manufacturers.

These Ottawa Loaders and their attachments have enabled State highway departments and other light industrial tractor owners to cut light tractor operation costs over $\frac{1}{2}$. Keep your tractors working all year 'round. Here are some of the jobs the Ottawa Hydraulic Front End Loader will make it possible for your light tractors to do when they would normally be idle.

- 1 Load trucks with cinders, sand or salt for treatment of icy streets or highways.
- 2 Clear sidewalks of snow using right or left angle snow blade attachment.
- 3 Snow removal from Business district streets by using light bulldozer.
- 4 Backfilling and leveling of roadway shoulders with light dozer blade.

GET MORE WORK OUT OF THE TRACTORS YOU NOW OWN

Consult your industrial tractor dealer, if he can't supply you have him write or write yourself for full information and price list.



Ottawa

STEEL PRODUCTS, Inc.
INDUSTRIAL DIVISION
OTTAWA, KANSAS • U. S. A.

THE RIGHT STRUCTURE

FOR LOWER DRAINAGE COSTS

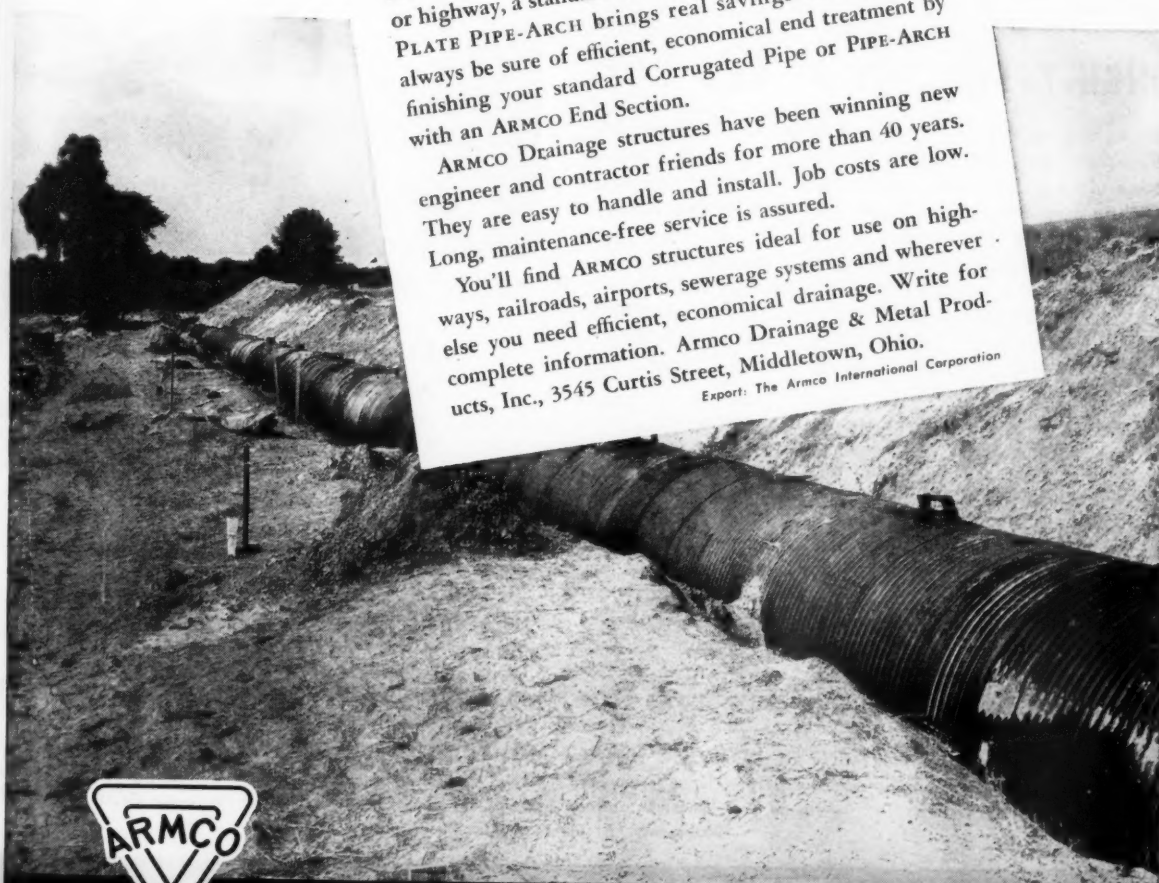
Choosing the right structure for the most economical drainage is no problem when you come to ARMCO. Here you can select the *one right type and size* for your needs.

There is plain galvanized ARMCO Corrugated Metal Pipe for normal usage—PAVED-INVERT Pipe to check erosion—ASBESTOS-BONDED Pipe where severe corrosion is a problem. For larger structures ARMCO MULTI-PLATE Pipe or Arches are prefabricated and delivered to the job site ready for immediate assembly. Where headroom is limited, or where you have to "duck under" a railroad or highway, a standard corrugated PIPE-ARCH or MULTI-PLATE PIPE-ARCH brings real savings. And you can always be sure of efficient, economical end treatment by finishing your standard Corrugated Pipe or PIPE-ARCH with an ARMCO End Section.

ARMCO Drainage structures have been winning new engineer and contractor friends for more than 40 years. They are easy to handle and install. Job costs are low. Long, maintenance-free service is assured.

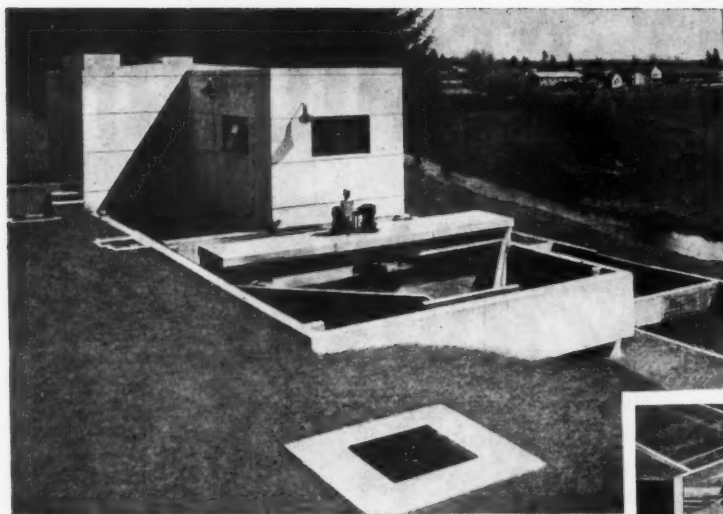
You'll find ARMCO structures ideal for use on highways, railroads, airports, sewerage systems and wherever else you need efficient, economical drainage. Write for complete information. Armco Drainage & Metal Products, Inc., 3545 Curtis Street, Middletown, Ohio.

Export: The Armco International Corporation



ARMCO DRAINAGE STRUCTURES

When writing, we will appreciate your mentioning PUBLIC WORKS



HERE'S A "PACKAGE" TREATMENT PLANT THAT FITS A MODEST BUDGET

**MODERATE FIRST COST, HIGH DEGREE OF
PURIFICATION AND EXCEPTIONALLY LOW
OPERATING COST MAKE THIS DEPENDABLE**

**UNIT IDEAL FOR
SMALL COM-
MUNITIES UP TO
3500 PERSONS
AND ISOLATED
PLANTS AND
INSTITUTIONS**

Many small communities and outlying plants, compelled on the one hand to purify wastes in order to stop pollution, but lacking ample supply of diluting water, have solved their seemingly insoluble difficulty by means of the Yeomans "Package" Aerifier activated sludge plant.

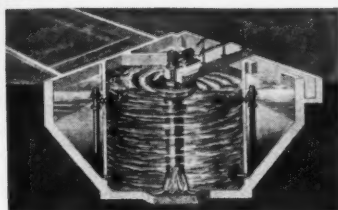
HIGH EFFICIENCY AT LOW COST

Here indeed is a highly efficient means of purification designed to fit the modest budget. In a single compact concrete unit of minimum dimensions you get aeration and final sedimentation; producing crystal-clear effluent at remarkably low over-all plant cost. Because there are no odors or flies, the plant can be located near habitation. Operation is simple, with supervision limited to routine check-up. All units are open for visual inspection. With its permanent concrete construction it is a plant that will perform efficiently for many years.

GOOD ENGINEERING

Each installation of the Yeomans Aerifier includes final adjustment, initial tested operation, thorough training of operators and continued counsel from an organization with a 50-year reputation for good engineering.

A Yeomans recommendation, based on data covering your needs, complete with construction cost estimates and application engineering, will be sent upon request.



Basic element of the "Aerifier" is the Yeomans "Spiralflo" mechanical aerator. Its essential parts are:

- a stationary up-draft tube
- a rotating aeration cone
- an electrical and mechanical drive unit to rotate the cone

By rotation of the cone, liquor is drawn up through the tube and thrown out in spiral waves—entraining air bubbles to permeate the entire content of the tank with oxygen. The tank content rotates gently, to preserve the floc and promote flocculation. Aeration is complete. There is no deposit of activated sludge on the tank bottom. Power consumption is low.

Other "Aerifier" parts are adjustable loading funnels, angular corner clarifier compartments, automatic return for activated sludge to the aeration tank, and automatic return of excess activated sludge to the primary tank.

These bulletins will be found most helpful—write for them:

"Spiralflo" Aerator—a full description of this simple, highly efficient unit.

Bulletin 6601

"Aerifier"—for activated sludge plants—a complete explanation of design, construction and operation principle.

Bulletin 6651

YEOMANS BROTHERS COMPANY, 1425 NORTH DAYTON STREET, CHICAGO 22, ILLINOIS

FOR HANDLING AND TREATMENT OF DOMESTIC SEWAGE AND INDUSTRIAL WASTE, YEOMANS MANUFACTURES

Yeomans Aero-Filter—high capacity trickling filter process • Yeomans "Package" Aerifier—activated sludge process • Rectangular and Circular Sludge Collectors • Digesters • Centrifugal and Pneumatic Sewage Ejectors • Scum, Grease and Sludge Pneumatic Ejectors • Rotary Distributors • Plunger Sludge Pumps



1898

YEOMANS
50 YEARS OF PUMP EXPERIENCE

1948

When you need special information—consult the READERS' SERVICE DEPT. on pages 81-84



Basin No. 1, Capitol Hill Reservoir: Left, new floor and side walls; right, new walls with old lining in background.

Denver Rebuilds a Water Works Reservoir

D. D. GROSS

Chief Engineer, Board of Water Commissioners, Denver, Colo.

IN 1888 the company that supplied Denver with water built a reservoir on Capitol Hill, then out on the prairie but now in the central part of the city, which is known as Basin No. 1. This had a capacity of 7 mg. It is now being replaced with a larger basin which will have a capacity of 24 mg, giving a total storage capacity, including Basin No. 2, of 52 mg. (Incidentally, we learn from the records that excavation for the original basin was done for \$0.12 a cubic yard, against \$1.10 for the present construction. However, the latter included some excavation of shale, which the former did not.)

This old reservoir had an irregular floor, since the shale bottom had not been leveled off; the lining was in bad shape, and the wooden roof was in an abominable condition. Recently it became imperative that more storage capacity be provided and it was decided that the best use that could be made of the area occupied by this old basin would be to include it in a new and much larger one. This is the first of the larger structures to be built under the Board of Water Commissioners' proposed \$30,000,000 improvement program. Another item of this program

is improvement of the filter plants, which is now under way. It is the Board's policy to postpone construction, so far as possible, beyond the present period of shortage of materials and labor, but the phenomenal growth of Denver since the war has created an imperative demand for more water, and the quickest and cheapest way to provide it is to increase the capacity of the filter plants, and make it possible to operate these more efficiently by increasing the reservoir capacity. With the latter in service it will be possible to operate the filters continuously at capacity, storing the excess at night for use the following day, and thus maintaining an immediately available supply of 17 mgd.

The pioneer operators of the Denver plant learned that Platte River water would support an undesirable growth of algae if exposed to sunlight, and covered the basin with a wooden roof. But while this prevented the growth of algae it did not exclude dust; therefore the design for the new reservoir provides for a concrete roof. The reservoir is 298 ft. by 458 ft., inside measurement, and 24 ft. high. The roof is a flat slab supported by 308 columns and

the side walls. The floor at the base of the walls is level around the entire structure, but within the walls it is divided into panels sloping to three longitudinal drains, which connect with the head drain discharging into a waste pipe to facilitate the washing of the basin. Water will enter the basin through a 60" conduit, and leave through 42" and 30" distributing pipes; also through a 48" pipe supplying the Capitol Hill pumping station.

Construction joints are provided to facilitate the pouring of the concrete but there are no expansion joints; as nearly as is structurally convenient the reservoir is a monolith. Its construction required 77,000 cu. yd. of excavation, 10,000 cu. yd. of Class A concrete, and 900 tons of reinforcing steel. The estimated cost is \$764,700. J. T. McDowell & Sons, of Denver, have the contract for the construction.

It is proposed to construct, at a later date, two additional reservoirs, one on each side of this and using its east and west walls as parts of these later structures; in which event it will be possible to use all three basins as a unit, or to cut out any one of the three for washing or repairing.

SANITARY FILL OPERATION

The first year of operation of the Winnetka sanitary fill ended Dec. 31, 1947. Mr. Anderson has presented the following review and appraisal which, because of the full and precise information he supplies, should be of marked value to all municipalities faced with the problem of refuse disposal.

ROBERT L. ANDERSON

Superintendent of Public Works and Village Engineer, Winnetka, Ill.

THE Winnetka sanitary fill is located at the edge of the residential district on an area of about seventy acres previously acquired by the Village. The property was formerly a marsh and is poorly drained, necessitating construction of an outlet sewer and surface ditching to provide positive drainage. The soil is clay ranging from heavy to sandy, with some pockets of sand that runs when wet.

All refuse collected from a population of about 13,000, and a small amount contributed by miscellaneous private haulers, has been placed in the fill with the exception of bulky brush from tree removals or pruning, which was burned at another location on the disposal site. Materials included wrapped garbage, household rubbish, ashes, yard rubbish and commercial rubbish, the last consisting largely of bulky crates and boxes mixed with garbage. No segregation either in collection or disposal was practiced.

General Operation Method

The general method of operation was the filling of a trench about four feet deep by ten feet wide in one-foot layers to a depth about four feet above original grade, thoroughly compacting the waste material by running over it repeatedly with a crawler tractor, and covering with two feet of dirt taken from an adjoining strip to create a new trench for further filling. Sides and ends were covered each day with at least 6" of dirt. A departure from the general scheme was the intermittent practice of making the fill in two lifts, the first to original ground level and the second to final level above grade, with temporary covering of the first lift. This was a useful procedure particularly in wet weather when the tractor could

not operate in the trench bottom except with great difficulty. A wall of dirt about three feet thick was left between trenches when the first excavation was made to insure against slides because of pressure of the overburden. This was normally trimmed down to one- and one-half feet or so by the tractor in filling the second trench, the material being used for temporary covering of ends and sides.

Equipment Used

Equipment used consisted primarily of a tractor and a drag-line. The latter was a 1/2-yd. unit, equipped with a 30-ft. boom. This machine was used to handle the bulk of the excavation of the new trench and is considered necessary because of the wet

nature of the site which makes tractor operation below grade impossible at times. Its use averaged less than two hours per day.

The tractor is a DDH Cletrac, equipped with a Model 60 Drott Bull-Clam and a cab fabricated in our own shop. It is used an average of five hours a day for placing, compacting and covering the fill and maintaining roadways for access. It has proved to be particularly well adapted and versatile for this work. A used 2 1/2" Jaeger centrifugal water pump with hose was also obtained to pump out the trenches below the elevation of the outlet drains. A sheet metal building was erected for housing the tractor and as a shelter for the operator and his supplies, etc. It is 20'x20'x10', furnished by Armco and cost \$1010 erected complete.

Personnel requirements are a minimum. The entire normal operation is handled by one man who operates both the tractor and drag-line. He was chosen for reliability and a conscientious attitude since the entire success of the system depends upon meticulous care in operation. He has been entirely job-trained to handle the ma-

TABLE I—QUANTITY OF REFUSE COLLECTED

	Mixed Household Wastes		Rubbish		Average
	Packed	Loose	Commer- cial	Misc. Mixed	
Est. Vol. C.Y.	9,115	12,601	152	16,725	277
Weight per C.Y.	650 lbs.	475 lbs.	1,000 lbs.	200 lbs.	475 lbs.
Weight, Tons	2,963	2,987	76	1,673	66
					7,765

TABLE II—CAPITAL EQUIPMENT DEPRECIATION

Item of Equipment	Book Value	Estimated Life	Annual Depreciation
Dragline	\$ 8,484.05	20	\$424.
Tractor Bull-clam	8,421.88	15	561.
Pump	130.94	15	9.
Shelter Buildings	1,009.92	15	67.
	\$18,046.79		\$1,061.

TABLE III—ANALYSIS OF OPERATING COSTS

	Operating Expense	Extra Expense	Total Expense	Total Cost Per Ton
Labor	\$3,130.53	\$1,051.07	\$4,181.60	\$0.539
Equipment	934.16	225.44	1,159.60	0.149
Materials and Supplies	47.02	199.15	246.17	0.032
Total "Out of Pocket" Expense	\$4,111.71	\$1,475.66	\$5,587.37	\$0.720
Depreciation	1,061.00	—	1,061.00	0.137
Total Expense	\$5,173.00	\$1,475.66	\$6,648.00	\$0.857



Left, enclosed collection truck and dragline; right, trench ready for refuse, with completed fill at right.

chines, having had no previous experience with either type of equipment. Most of his time is occupied in placing, compacting and covering refuse with the machines, with some hand clean-up of papers, operation of pumps, lubrication and care of machines and miscellaneous duties taking up his full time. Extra labor has had to be furnished for part of the road work, frost-breaking and a few miscellaneous jobs.

The commencement of operations in the middle of winter without full preparation, as well as the necessity for providing the basic drainage ditches occasioned considerable expense beyond the normal operating costs for the first year's operations. Most of this will be non-recurring and is separately accounted for in the cost figures following.

Quantities and Compaction

A record has been kept of all material placed in the fill based upon a careful but necessarily approximate estimate of truck body volumes delivered and a record of the condition of each load. Five principal classes of material were delivered, average unit weights of which were based upon considerable earlier experience with actual weighed loads. Quantities are shown in Table I.

At completion of the year's operations the filled area was carefully cross-sectioned and computed to determine the compacted volume and hence degree of compaction, with the following results:

Area covered, 1.32 acres; volume of fill, 7,965 cu. yds.; average depth, 3.74 ft. above original grade; maximum depth, 6.5 ft. above original grade; compaction, 38,770 cu. yds. to 7,965 cu. yds. or to 20.5% of the original volume; density, 7,765 tons in 7,965 cu. yds., or 0.976 tons per cu. yd., or 1,954 lbs. per cu. yd. of compacted fill.

The relatively low average height above original ground level is occasioned by a gradual build-up from original ground level. This was considerably more accentuated than desirable or intended because of our lack of experience with the operation, and part of the area should later be filled to a higher grade. This affects the area covered, making it somewhat larger than would be used if the intended 6-foot depth were maintained throughout. Thus for future operation it is estimated an area of about 0.9 ac. per year should suffice at an average depth of 5½ ft. which allows for necessary slopes at the edges.

The compaction figure of 20.5% of original volume is an over-all figure, but the individual classes vary widely. It is estimated the commercial rubbish which consists largely of boxes, crates and waste paper compresses to less than 10%. Loose mixed household wastes are delivered in open dump trucks and probably compress a little less than the average, perhaps to 25%. Packed mixed household wastes are delivered by enclosed trucks with packer units and are partially compressed when delivered, so their final compaction is probably not more than 50%. Clear ashes of course, of which the volume was small, compress very little.

Cost Data

The year's operations have been analyzed with a view to separating the elements of costs and also to segregating ordinary operating expenses from extra costs.

Depreciation on capital equipment was calculated in accordance with the schedule shown in Table II, which does not include any allowance for land expense, since the property was acquired for other purposes. An analysis of the costs of operation is given in Table III. The following

comments relate to the data shown in that table. (1) No costs are included for supervision or office overhead. (2) Compensation scale for the principal operator averaged \$241 per month for the year. Other incidental labor averaged \$230 per month. (3) The item "extra expense" consisted largely of expenditures for keeping a passable access roadway, providing additional drainage channels and facilities and breaking frost, at least two-thirds of which is of a non-recurring nature. (4) On this assumption, out-of-pocket cost for normal operation is estimated about \$4,600 and the corresponding unit cost figure at \$0.593 per ton. Including depreciation the normal unit figure should be \$0.730 per ton. These are considered the significant figures for future operations.

For purposes of comparison, the cost during 1945, 1946, and that part of 1947 when an open dump was used, ranged from 47¢ to 52¢ per ton. In previous years, when incineration was employed for disposing of garbage, waste paper and commercial rubbish only, the ton costs were considerably higher, based on the much smaller amount of material handled and including interest on the investment. For the open dump, much longer hauls were necessary, offsetting all of the apparent saving in ton costs over the present system.

Conclusions

Our first year's experience has been eminently satisfactory. Operation has complied with desirable public health and nuisance standards. Rodents are entirely absent, and flies practically so. There have been no troubles over odors. Only one fire has occurred; this was caused by hot ashes and was easily smothered by covering with dirt.

Certain operating difficulties have been encountered although all have

(Continued on page 72)

Average
& Total
38,770
400 lbs.
7,765

Annual
Depreciation
\$424.
561.
9.
67.

1,061.

Total Cost
Per Ton
\$0.539
0.149
0.032

\$0.720
0.137

\$0.857

Soils Laboratories . . . Classification . . . Surveys . . .

Embankment and Subgrade Compaction . . . Subgrade Treatment

SUBGRADE SOIL PRACTICES

THE Committee on Concrete Pavement Design of the American Road Builders' Association has conducted a fact finding survey to learn the present practice concerning concrete pavements throughout the country. Questionnaires sent to the various state highway departments and the District of Columbia were received and tabulated in 1947, under the three heads—"Subgrade Soil Practices," "Concrete Materials, Proportioning, Placing and Curing," and "Structural Features of Concrete Pavements."

The data tabulated under the first head have been summarized and analyzed by Tilton E. Shelburne, Director of Research, Virginia Dept. of Highways and the member of the Committee on Concrete Pavement Design in charge of this subject. His summary is given below.

Soil Laboratories and Classification Methods

All but three state highway departments now have a central soils laboratory. Vermont reports no central soils laboratory; however, it states that relatively deep field borings are made for all projects and since there is an abundance of glacial gravels, a gravel subbase 12 to 24 inches in thickness is employed under all pavement types. As might be expected, the number of employees devoting full time to soils work varies from one or two in some states to as many as 135 in New York state. It is estimated that approximately 650 employees are now devoting full time to soils work in the 49 agencies reporting.

Field soil laboratories have been established by twenty-four departments either at district or division headquarters. Others do all soils testing at a central laboratory. Some states have trailer or portable field laboratories. It is indicated that approximately 150 field laboratories have been established by 24 agencies.

The method of soil classification varies with the different states. Most states (38) use the Public Roads Administration method or some mod-

ification to meet local conditions. The survey revealed that five states are now using the Group Index¹ or Highway Research Board method for classifying subgrades and granular material. Nine states are making use of the pedological system, primarily as a means of identifying the soils, determining problems to be encountered and for preliminary work; however, Michigan has used this system extensively, having started a study of the engineering significance of soil types in 1925. An elaborate soils manual describing the soils and giving definite design and construction recommendations has been published. Several states, including Georgia, Maryland, Mississippi, New Hampshire, and Ohio use a modification of the P.R.A. system. Three departments make use of the CBR test as a method of classifying subgrade soils. Likewise, three agencies use the Corps of Engineers or Casagrande classification. Other states classify the soils according to texture or use a system particularly applicable to local conditions.

Soil Survey

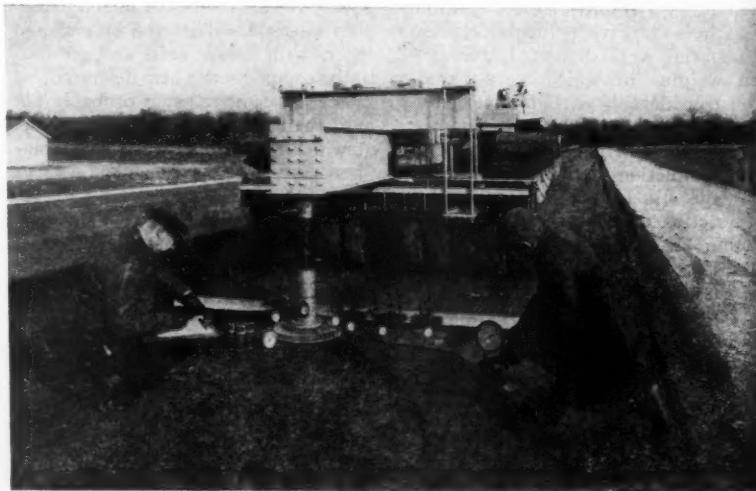
Twenty states follow AASHTO method T86-42 for making soil surveys and sixteen other states use this method in part or with some modifi-

cation. Soil surveys are not made by twelve states. County agricultural soil survey maps and reports are utilized by twenty-eight state highway departments. Kansas states "They aid in determining the number of samples, location of special borrow, the identification of soil series and evaluating the soils encountered for use in various portions of the structure." Others emphasized that these maps are used in preliminary studies. Eight states indicated that some use has been made of aerial photographs in connection with the identification or location of soil areas. Ohio reports that aerial photographs have been used in locating granular deposits and that the department now has its own aerial photographic facilities. Twenty-eight states report the making of complete soil profiles for each concrete pavement project, while others profile only certain projects or in those areas where difficulties are anticipated.

Embankment Compaction

The compaction of embankments and subgrades is an item to which highway departments have given in-

¹ Report of Committee on Classification of Materials for Subgrades and Granular Type Roads, *Proceedings of the Twenty-Sixth Annual Meeting of the Highway Research Board*, January, 1946, pp. 375-392.



Load tests to determine the weight-bearing capacity of an experimental pavement.

Courtesy Public Roads Administration

creased attention in recent years. Equipment manufacturers and contractors are to be complimented on the progress made in earth-moving equipment and methods. In our opinion these contributions mark the greatest progress in road building in recent years.

The survey revealed that 36 states now specify some type of control procedures for embankment compaction. The majority (23) specify Proctor compaction (AASHTO T99), although some specify modified Proctor. A minimum number of passes of the roller ranging from 4 to 15 is specified by seven states. The maximum thickness of layers for soil embankments ranges from 4 to 12 inches and averages about 8 inches. The percentage of compaction required varies with the tests specified; however, many states specify AASHTO M57-42, which is a range of 90 to 100 per cent. One state reported a specification of 85 per cent compaction on secondary roads and 90 per cent on primary highways. Two states, California and Massachusetts, specify the amount of rolling equipment. For example, California requires one three-wheel roller or one eight-foot width of sheepfoot roller for each 150 cubic yards of embankment placed per hour, while Massachusetts specifies that at least one power or tamping roller shall be provided and in constant use for each 100 cubic yards or fraction thereof of embankment material placed per hour. An optimum moisture content is specified by 20 highway departments. Some permit a variation from optimum, usually about 2 per cent, while other states indicate no permissible variation from optimum.

Subgrade Compaction

The specifications for subgrade compaction are the same or similar

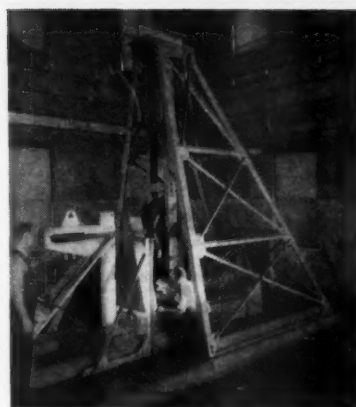
to those for embankments for 27 departments; however, other states have more rigid requirements for subgrade than for embankment compaction. Ohio, for example, specifies 90-102 per cent compaction for embankments and 95 to 105 per cent compaction for subgrades. Many departments are now specifying that the portion of the subgrade in cuts be scarified and recompact to the same degree as that in embankments. The depth varies from six to twelve inches. Many departments (21) compact the subgrade beyond the form width to the outside shoulder edge, while others compact only within the form lines or a foot or two beyond.

Subgrade Problems and Treatment

With the variety of soil and climatic conditions that exist throughout the country it is anticipated that subgrade problems and their consequent treatment will be different. It is interesting to note that pumping of rigid slabs is the most general problem (33 states) while that of frost action runs a close second. In general, the frost action problem is confined to the northern half of the United States. Numerous other problems are listed and include high-volume-change soils, organic soils, sulphate soils, poorly-drained soils, settlements and bentonite.

While it is not feasible to discuss in detail the treatments used by the different departments, the replies indicated that in general the treatment for these problems consisted of a blanket or insulation course of either good soil, local materials or a well-graded granular material.

If soils are utilized for subgrade treatment, most states specify that the plasticity index (P.I.) shall be low, usually six, or less. Others specify no plasticity in the minus No.



Courtesy Public Roads Administration
Equipment for impact tests.

100-mesh material. Still others require that at least 50 to 55 per cent of the soil be retained on the No. 270 sieve. Some specify limiting grading or texture requirements.

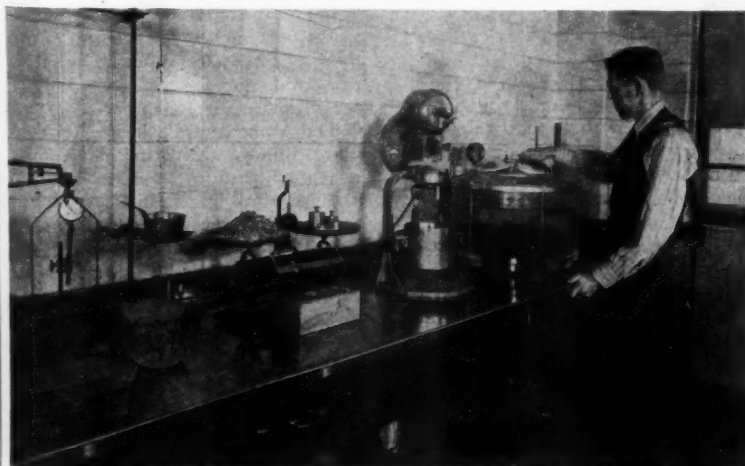
In the case of granular materials some departments have very exacting grading requirements, others have very flexible specifications. As a specific case, one state permits a top size of five inches, another three inches, and still another one-inch maximum size aggregate.

The depth of subgrade treatment or blanket insulation course varies considerably according to the problem and location. Some states may use layers as thin as two inches to prevent pumping while others employ a depth up to 48 inches for prevention of frost action. Some states (Minnesota and Michigan) even indicated a variation in depth of treatment from the southern to the northern portion of the state, because of climatic conditions.

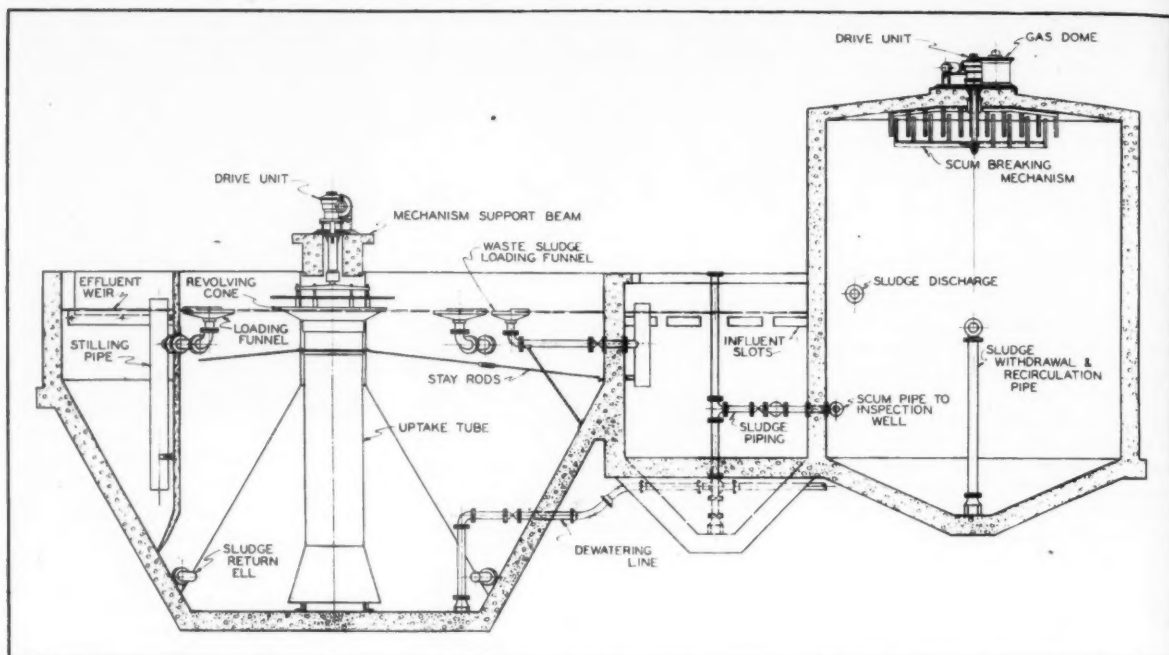
Highway engineers are apparently not in accord as to whether the subgrade treatment material should be a relatively-dense or a porous, freely-drained material. It is possible that this difference of opinion results from a lack of uniformity in nomenclature. In totaling the replies only 16 prefer the relatively-dense as compared to 38 which prefer the porous, easily-drained material. Some states reported that both are used—the porous, easily drained material on a fine-grained subgrade soil and the relatively-dense material on a cohesionless or sandy soil.

The same question was asked concerning shoulder material. In this case only thirteen states prefer the relatively-dense material, while 32 indicated a preference for the porous, easily-drained shoulder material. Many states indicated that porous subgrade treatment material is ex-

(Continued on page 68)



Courtesy Public Roads Administration
The laboratory prepares bituminous mixtures for compression tests.



Section through Yeomans plant. Left to right, aeration, primary settling and digestion tanks.

Small Sewage Treatment Plants

V-Activated Sludge

This is the fifth in our series of articles on small sewage treatment plants. It was prepared at our request by Robert C. Gloppen of Yeomans Bros. Co. The plants he describes are available in three basic designs and in sizes to serve populations of 500 to 3,500, each size of unit being engineered to meet necessary local conditions. The illustrations herewith show how it is possible to produce highly attractive plants to meet the needs of the smaller communities. According to the survey of the U. S. Public Health Service, 9,058 small communities are in need of sewerage facilities.

R. C. GLOPPEN
Yeomans Bros. Co.

IN THE activated sludge process, the raw sewage is first screened; it then flows into a primary settling tank, where the heavier solids are settled out. The partially clarified liquid from the primary tank passes into the aeration tank for secondary treatment. The solids from the primary tank are transferred to a sludge digestion tank, from which they are later drawn to sludge drying beds for drying and final disposal.

The settled sewage from the primary tank contains a good deal of organic matter in the form of finely divided material which is in both solution and suspension. It is the

treatment to remove or stabilize this organic matter that constitutes the secondary and most important portion of the sewage treatment process. The settled sewage entering the aeration tank is agitated and circulated by the mechanical aerator. During the aeration period a floc is developed which consists of sewage particles, bacteria, and other living organisms, and this floc (called activated sludge), when introduced into the incoming raw sewage, increases the rate of flocculation or coagulation considerably. The mixture of floc and raw sewage in the aeration tank is called "mixed liquor" and

after proper aeration this mixed liquor passes into the final settling tank. Here the activated sludge settles out readily and the clear liquor is discharged as the plant effluent.

The sludge settled in the final tank is collected and pumped from the tank, a portion (return activated sludge) being discharged to the aeration tank for seeding and maintaining the mixed liquor concentration, and the balance (waste activated sludge) being discharged to the primary tank, where it settles with the raw solids and is sent to the digester for ultimate disposal.

The Yeomans "Package Aerifier" plant follows the principles of the activated sludge process, but the plant design has been so arranged as to result in low construction cost and insure ease of operation. The basic units comprising the design are described briefly as follows:

Raw Sewage Screening

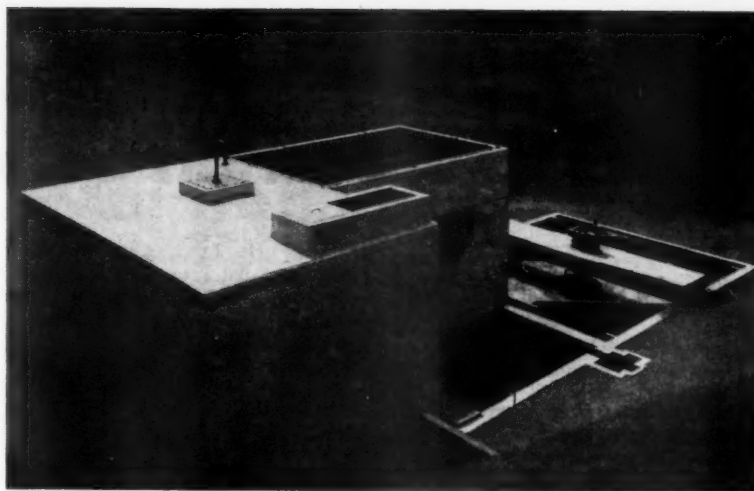
The average small plant design does not justify the expense of mechanical screens, and as a result, the operator is faced with the disagreeable task of raking the bar screen and removing and burying the

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conven
solution
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screened material. In the "Aerifier" plant, automatic screenings handling is provided. This is obtained through the use of a pneumatic screening and sludge ejector, which is a single unit designed for handling all sludge and screenings at the plant. The screen is a horizontal, submerged bar screen located in a small hopper bottomed screen channel. The raw sewage enters the screen channel below the screen and must flow upward through the bars, thereby causing all screenable material to be retained on the under side of the bars. A pipe leads directly to the pneumatic ejector. To clean the screen, the operator merely opens a gate, thereby back-flushing the bar screen and carrying the screenings to the inspection well, whence they flow by gravity to the ejector. This discharges to the digestion tank. The screenings are not touched by the operator, and the whole operation consists of opening and closing the gate.

The scum line from the tilting skimming pipe and the sludge line from the hopper of the primary settling are also connected to the inspection well. To skim the primary tank, it is necessary only to move the pipe to the skimming position. Sludge is withdrawn from the primary settling tank by opening the valve on the sludge line which, by hydrostatic head, discharges to the inspection well and ejector. Use of the inspection well permits examination of the sludge as it is withdrawn.

The ejector is also used for recirculation of the digester contents; and if it becomes necessary to add lime to the digester, it can be done conveniently by adding the lime solution to the inspection well during recirculation.



A typical small installation, showing neat design.

Preliminary Sedimentation

These plants utilize a rectangular primary settling tank which, with the exception of a few of the smaller designs, is equipped with Yeomans' "Streamline" sludge collecting mechanism. The collector removes the settled solids to the sludge hopper and skims the scum accumulation on the surface of the tank to the tilting skimming pipe. Removal of scum and sludge from the primary tank was described in previous paragraphs.

In the smaller designs, a hopper bottomed primary tank is used which, of course, has no sludge collecting mechanism.

Aeration and Final Sedimentation

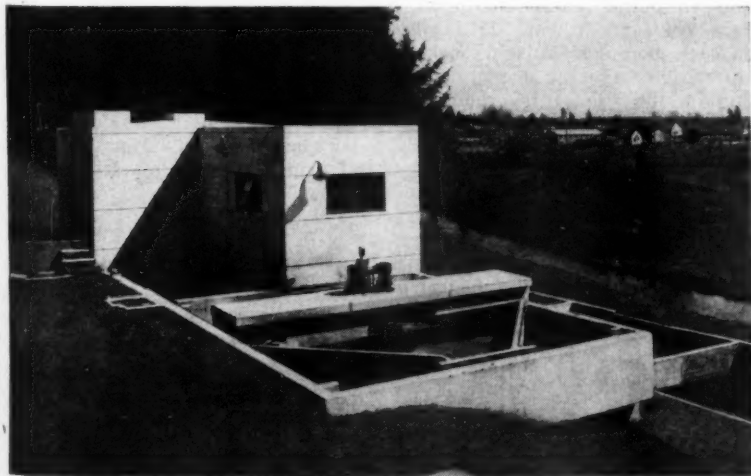
In this plant, the aeration tank and the final clarifier are combined in one concrete structure. This is

accomplished through the use of a hopper-bottomed concrete tank having the four corners separated from the main body of the tank by concrete baffle walls. The center portion of the tank forms the aeration compartment and the combined volume of the four corner compartments provides the required final sedimentation period. This combination unit (the "Aerifier") permits a saving in construction cost by elimination of a separate final clarifier and collecting mechanism.

Each "Aerifier" is equipped with a Yeomans "Spiralflo" mechanical surface aerator. This unit consists, basically, of a vertical updraft tube, a rotating aeration cone assembly at the liquid surface, and a slow-speed mechanical and electrical driving unit. The rotating cone draws the mixed liquor up through the draft tube and throws it out over the entire tank surface in minute particles, providing a maximum liquid surface for absorption of air. At the same time, it imparts a circular motion to the entire tank contents, which, when combined with the downward motion to the entrance of the draft tube, creates a spiral motion throughout the tank volume. This is of sufficient velocity to prevent deposition of solids. The tank bottom is kept clean at all times and the air absorbed at the tank surface is mixed throughout the whole volume of liquid.

The settled sewage from the primary tank enters the aeration compartment and is subjected to the mixing and aeration action described above for a period in accordance with the design capacity of the plant. The rotating cone creates a wave action over the surface of the aeration com-

(Continued on page 71)



Another view of a modern small activated sludge plant.

How Cities Charge for Private Fire Protection Services

This is a continuation of the data initiated in our May issue. The remainder will appear in an early issue.

Middle Atlantic

New Jersey.—Burlington, Alonzo Shinn, Supt., has an annual service charge of \$10; each hose line, \$1; sprinkler heads up to 25, \$25; over 25, 10¢ each. Elizabeth, Samuel F. Newkirk, Jr., Engr. & Supt., Bd. of Water Commissioners, reports a charge of \$15 per quarter for a 4" meter, \$30 for a 6", and \$45 for an 8". Clifton, John T. Fitzgerald, City Engr., in charge of Div. of Public Works, reports the charge is based on the service charge of the corresponding size of the meter. Montclair, Chas. G. Bourgin, Supt., charges as follows: 2" connection, \$5 per quarter; 3", \$10; 4", \$15; 6", \$30; and 8", \$60. Somerville and Raritan, Sylvester E. Ward, Supt., makes a charge, depending on the size of the meter. Washington, Edward Feldman, Mgr. Washington Water Co., charges \$10 each yearly for hydrants only; charging for sprinklers is contemplated in the near future. No charge is made by Hammononton, Madison, Manville, Perth Amboy, Pitman, Rahway, South Orange and Verona.

New York.—Bath, Frank Noll, Supt., Bath Electric, Gas & Water System, charges \$15.75 quarterly for a 6" connection, plus estimated use of water in case of fire. Buffalo, Jerome C. Kreinheder, Dir. of Water, makes a charge of \$12 a year. Corning, Carl F. Wilson, Supt. of Public Works, reports a charge of \$5 per year to cover the cost of inspection by water department personnel. Garden City, A. H. Rogers, Supt. of Public Works, charges from \$3.75 quarterly for 2" connections to \$21 for 6" and 8" connections. Mamaronck and Harrison, W. E. Thrasher, Supt., Westchester Joint Water works No. 1, make a charge of \$90 yearly for 6" connections and \$60 for 4". Norwich, Clarence F. Ames, reports that the charge depends on the size of service. Ogdensburg,

Charles H. Lord, City Engineer, charges a flat rate of \$1.00 a year. Olean, Nelson M. Fuller, San. Engr. & Supt., charges \$3 per quarter for each system. Oneonta, Grover E. Rickard, Supt. of Water & Sewage Treatment, has a flat rate of \$25 a year. Port Jervis, Russell J. Von Sauers, Water Commissioner, also charges a flat rate of \$25 a year. Saugerties, William R. Johnson, Supt., Water Commissioner, makes a charge of \$25 yearly for factories. Tarrytown, James R. Losee, Engr. & Supt., Water Dept., reports a charge of \$10 per year per inch diameter of service line. Utica, L. J. Griswold, Engineer, reports yearly charges as follows: 4" service, \$40; 6", \$50, and 10", \$100. Walton, D. W. De Witt, Manager, charges 1.9¢ per month for the first 500 gallons, and 1.4¢ for the balance. Waverly, Lester R. Marshall, Supt. of Water, makes annual charges as follows: standpipes up to 25,000 gallons, minimum, \$10; additional \$2 for each 5,000 gals.; heads \$15 for 500; 5¢ per head additional; hydrants \$5 each. No charge is made by Avon, Batavia, East Aurora, Elmira, Freeport, Fulton, Johnstown, Lancaster, Liberty, Little Falls, New York City, Oneida, Ossining, Peekskill, Penn Yan, Ravena, Tonawanda, Watertown and Wellsville.

Pennsylvania.—Ambler, Chas. A. Hibsman, Borough Supt., reports the charge is usually the same as the private fire hydrant charge which is \$25 a year. Ashland, H. L. Burmeister, Borough Manager, makes a quarterly charge, the amount depending on the size of the connection: 1", .75; 1¼", \$1; 1½", \$2; 2½", \$3; 3", \$4.25; 4", \$7.50; 6", \$17. Bloomsburg, W. McK. Reber, Pres., Bloomsburg Water Co., says the charge depends on the size of service. Bradford, Chas. M. Stewart, Supt., charges for outside the city limits only, based on the number of sprinkler heads at 7¢ per head. Butler, Geo. K. Leary, Mgr., the Butler Water Co., charges annually as follows: Fire hydrant, \$50; 1 to 500 sprinkler heads, \$25 each, additional, 5¢; hose openings, \$12.50. Chambersburg, Robert Monn, Supt. of Water & Sewers, report the domestic rates are 50¢ per month. Clearfield,

W. B. Kennard, Mgr., Mun. Authority of Clearfield, makes yearly charges of \$150 for a 6" supply, 3,000 heads, and \$75 for a 4" supply, 1,500 heads. Corry, H. A. Gilbert, Secretary and Treasurer, reports the charge for a 4" connection is \$50; 6", \$125, and 8", \$225. In Danville, Le Roy Deitrick, Supt. Water Dept., the charge is on a flat rate basis of \$75 per year. Ford City, P. J. Wintgens, Supt., reports the monthly charge is \$2 per inch of pipe. Freeport, George W. Wilson, Pres., Boro Municipal Authority, states the charge is \$20 per year. Grove City, W. D. Breckenridge, City Manager, charges \$3 per month per connection. Lansdale, C. R. Ridington, Supt., reports the annual charges are determined by the size of the service line: 4", \$25; 6", \$50; 8", \$100. If customer has a water tank, the respective charge is doubled, and 2 annual tank fillings are allowed. Manheim, Chas. M. Geib, Supt., charges \$6.25 per quarter for fire hydrants and 2½¢ for sprinkler heads. McDonald, J. W. Lawrence, Mgr., makes a charge of \$4.17 per month. Northampton, J. C. De Groot, Mgr., Northampton Boro. Mun. Authority, charges 5 mills per sq. ft. per year with a minimum annual charge. Oakmont, W. H. Bottelsen, Mgr. & Cons. Engr., charges \$15 per inch diameter per year. Sayre, Chas. C. West, Gen. Mgr., reports the charge is based on 1,000 sq. ft. of floor space. Shillington, Irvin R. Herneisen, Supt., charges a flat rate: private fire hydrants, \$50; sprinklers, 4" and under, \$35; 6", \$50. The following cities do not charge: Duquesne, Freeport, Hazleton, Lansdowne, Lebanon, Morrisville, Mt. Union, Oil City, Philadelphia, Phoenixville, Sewickley, Shippensburg and Titusville.

South Atlantic

Florida.—Gainesville, Lake Worth and Melbourne make no charge for this service.

Maryland.—Easton and Salisbury each report no charge for such service.

South Carolina.—Greer reports that no charge is made for such service.

**Abstracts from Highway
Research Board Papers**

Highway Design, Construction and Maintenance

Jacked-in-Place Drainage Pipe

JACOB FELD

Consulting Engineer, New York, N. Y.

FROM the point of view of safety, a roadway partially blocked during the construction of additional drainage or other sub-surface structures, is worse than no road at all. Even after completion of the pipe installation, the temporary roadway and the final surface patch are constant points of hazard.

There is no reason why the established procedure of jacking pipe is not an accepted standard for the numerous pipe installations across completed roadways. This paper, which was presented at the 27th annual meeting of the Highway Research Board, describes the various types of pipe jacking methods and cites examples of actual installations from 2-inch to 84-inch pipe sizes. Small pipes may be driven through any type of ground by either first boring or coring an opening, or by jacking with a static or vibrating force. Larger pipe sizes must be jacked into fills while the soil squeezed into the pipe is being removed. In most cases, a small scale tunnelling operation progresses directly ahead of the pipe, thereby reducing the necessary jacking force, or permitting a longer advance with available jacks.

Tabulations of actual installations of both concrete and corrugated metal pipes, since 1926, shows successful cases of pipes jacked over 100 feet from one location and in fills of various soil types. Depths of pipe varied from 3 ft. minimum cover below railroad tracks to 66 ft. in a slag dump.

Analysis made up of the actual jacking pressures required indicates that the forces acting on the pipe during movement can only be explained by the assumption that the disturbed soil is in a viscous state. Evaluation of the necessary jacking pressures are made for each case of installation. Strength of the pipe used is no greater than the standard culvert pipe, since soil loading pressures are less than are found under the most favorable trenching procedures.



Motor grader on mixed-in-place resurfacing, Ohio Route 598.

Courtesy Gallon

The cost of pipe jacked-in-place is often below the cost of open cut trenching methods if all surface restoration charges are included. Progress records, labor and other costs for several typical jobs are listed together with a bibliography of references describing actual installations.

Stabilized Turf Shoulders for Parkways

OLIVER A. DEAKIN

Parkway Engineer
New Jersey State Highway Department

THIS paper (before the Highway Research Board) outlines the problem of designing a stabilized turf shoulder suitable for parkway use and of constructing a sample section. Five different grass seed mixtures were used in seeding the experimental turf shoulder plots. Hay mulch was used at rate of 100 pounds per 1,400 sq. ft. Traffic delineators were placed fifty feet apart along the edge of the bituminous portion of shoulder to keep off cars and trucks for a two-month period until a good stand of grass was obtained. Tentative findings are that stabilized types of turf shoulders may be built during summer months and successfully seeded when combined with mulching practices. The use of a 3-foot bitumi-

nous transition strip along pavement edge eliminated wearing of turf next to the paved strip. The shoulder areas have proven satisfactory in both dry and wet weather and greatly improve the appearance of the Parkway.

Salvaging of Old Pavements in Ohio

C. R. HANES

Field Engineer, Bureau of Construction
Ohio State Highway Department

OHIO is fortunate in having many miles of all types of pavements of varying ages which provides a continuous test project for the development of methods and equipment for resurfacing and widening practices. Owing to the many comparatively recent developments in design and construction methods, the discussion in this paper is limited to widening with non-rigid bases of the macadam and bituminous concrete types and resurfacing with bituminous concrete.

It is important that salvaging of a pavement be done at the proper time to avoid unnecessary costs. One of the most important items in salvage construction is readiness for the salvage work to follow. In the case of old concrete pavements with rocking or broken slabs this may consist of undersealing or adding an insulation course to

the surface. It has proven more practical to add extra leveling material as separate courses over areas of partial failure than to remove and replace the old pavement. Most salvage projects now include widening. Placing of widening courses of macadam or bituminous concrete or a combination of the two general types without the use of forms has increased production, decreased labor cost and improved the stability of the widening. Placing of widening with self propelled strike off units has improved results and increased production. Use of the same composition bituminous concrete mix in narrow base widening courses as used in leveling and some top courses has improved the density and stability of the course, and at the same time improved contractor's operations. Asphalt of lower penetration is now being used on high traffic routes to provide increased stability. The open minded approach to salvage construction permitting the development of equipment and methods has resulted in improvements in equipment, methods and the finished product.

Flow Through Gutter Inlet Gratings

CURTIS L. LARSON

St. Anthony Falls Hydraulic Laboratory
Minneapolis, Minnesota

THIS investigation of the flow of water and entrained debris through gutter inlets of the grate type was conducted at the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota, under the sponsorship of the Minnesota Department of Highways. The purposes of the experiments were: (1) To obtain data on the performance of existing inlets; and (2) To develop inlets with higher capacity and greater ability to pass debris.

The inlets tested included two standard grate inlets, one with openings parallel to the flow, and the other with openings normal to the flow. Several experimental inlets were also tested. The original experimental inlet was constructed with bars and openings set at an angle of 45 deg. with the direction of flow. It was hoped that these openings would be self-cleaning as a result of the component of flow along the axis of the bars. This inlet was tested with various settings and improvements.

Each inlet was mounted full-scale in a simulated gutter in the laboratory titling channel, and capacity tests were conducted at several slopes and over a wide range of discharges at each slope. Quantitative tests with simulated debris were also made.

The tests showed that openings parallel to the flow intercept the water more readily than do openings normal to the flow. However, the width of the inlet is an important factor in determining its capacity. For example, the original experimental inlet has a capacity somewhat greater than either of the standard inlets tested, mainly as a result of its greater width. The tests also demonstrated that the capacity of this inlet can be increased substantially by a change in the form of its bars; an improvement which is applicable to any inlet with transverse bars. The debris tests indicated that only inlets with openings parallel or nearly parallel to the flow are self-cleaning.

Perhaps the most important fact developed by the tests is that the capacity of apparently any grate inlet can be increased greatly by permitting a small portion of the flow to pass over or around the inlet. This small amount of water, which was termed "carryover," is not cumulative and is therefore permissible for the case of inlets in series. Thus, by allowing a carryover of 0.10 to 0.20 cu. ft. per sec., the spacing of inlets in series can be approximately doubled.

From the test data in the form of rating curves, an inlet capacity corresponding to a permissible carryover can be selected. This capacity is the "normal" inlet capacity for the series, that is, the capacity per inlet under the design conditions. The inlet spacing can then be computed by equating the inlet capacity to the runoff per inlet. An example of ten inlets in series is given to illustrate the computation of the operating capacity of individual inlets under unusual circumstances, such as clogging of an inlet or excessive rainfall intensity.

Continuously Reinforced Concrete Pavements

SEVERAL states are investigating continuously reinforced concrete pavements. Details of designs were discussed at the Highway Research Board meeting last winter. W. W. Russell, Engineer of Materials, Illi-



Model A IHC wheel tractor with side mower and seven section Worthington pull mower cutting grass and weeds at Torre Haute's Hulman Field, 640-acre airport.

nois Division of Highways, described one of these pavements built last summer. This pavement is 22 feet wide, approximately $5\frac{1}{2}$ miles in length and is divided into eight test sections, six of which are approximately 3,500 feet and two approximately 4,230 feet in length. The pavement contains no transverse joints except those separating the different sections and no longitudinal joint, the transverse steel being continuous across the full width of the pavement.

Four of the sections are of 7-inch and four of 8-inch uniform thickness. Four percentages of longitudinal steel, based upon the cross sectional area of the pavement, were used with each thickness of pavement; namely 0.3, 0.5, 0.7 and 1.0 percent. The various percentages of longitudinal steel were obtained by using bars of different diameters and variable spacings. Rail steel bars, ASTM Designation A-16, were used for the longitudinal reinforcement. The transverse reinforcement consists of $\frac{3}{8}$ -inch intermediate grade billet steel bars spaced at 12 inches c-c over one half the length of each section and 18 inches c-c over the other half. The reinforcement was supported on chairs and was placed 3 inches below the surface of the pavement. The concrete was placed in one lift and to insure proper embedment of the steel the concrete was vibrated.

William Van Breemen, Engineer of Special Assignments, N. J. State Highway Dept., gave details of two sections of continuously reinforced pavement built in 1947 on Route 25 between Hightstown and Cranford. The northerly section is 5,430 feet long, of 8-inch uniform thickness, and contains 0.90 percent of longitudinal reinforcing steel. The southerly section is 5,130 feet long, of 10-inch uniform thickness, and contains 0.72 percent of longitudinal reinforcing steel. The project also included the construction of a series of experimental slabs 187-ft. 4-in. in length having an additional amount of longitudinal reinforcing steel within their central portions.

Reference lines were established to determine the magnitude of subsequent longitudinal movements of the ends and interior portions of the continuously-reinforced sections. Numerous gauge points were installed to permit determination of: (1) the widths of cracks; (2) changes in the lengths of various parts of the sections; (3) changes in the widths of all transverse joints and, (4) the amount of opening of the longitudinal joints. Series of gauge points were installed in the 187-ft. 4-in. slabs to determine the changes.

Dams in

PERMAFROST

By JOSEPH D. LEWIN

This is the fourth article in this series and the second on the design and construction of dams in areas where the ground is permanently frozen. The first article on dams appeared in our May issue.

the facing boards suffer from the wearing action of the ice sheet.

Rockfill Dams

Rockfill dams are economical, and provide excellent drainage, as well as aeration of the dam body, thus raising the permafrost table and insuring against permeability of the sub-soil strata. Rockfill dams may be protected by a waterproof blanket

IN constructing dams on sedimentary formations, particular attention should be paid to subsoil investigations, and the thermal regime of the dam site should be determined in minute detail. Locations having inclusions of ice should be avoided, unless specially treated, as by thawing the ice inclusions, and either filling the voids with grout; or consolidating by collapsing the subsurface soil by a modified method of vibroflotation. Modified vibroflotation using hot water, steam, or a water-steam combination instead of cold water, enables collapsing the permafrost to a depth of 100 ft. in a single application, and at the same time compacts the soil to its optimum density, thus providing considerable bearing value for the foundation of the dam. When the foundation site is decided upon and the datum of any future permafrost table ascertained, the type of dam can be chosen.

Timber dams, either of crib-type or of beartrap type, are suitable for low head dams. Materials may be available at the site, thus saving transportation. Timber dams are flexible

enough to adjust themselves to unequal settlements. They resist climatic conditions, are poor heat conductors, and do not require elaborate provisions for expansion. Such dams should have extra heavy facings and should

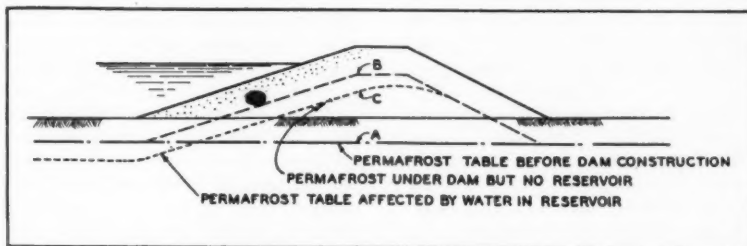


Fig. 2. Profile through dam. See also Fig. 1 in May issue.

be inclined downstream not less than 60° from the vertical, so as to allow the ice to creep up the face of the dam. Crib-type dams should be backfilled with dry coarse materials which will allow free drainage. Spillway provisions can be incorporated easily into the design of timber dams. However, such dams require maintenance, since

and an insulating layer on the upstream face, similar to those described hereafter for earthfill dams. Materials for the rockfill should be selected particularly for their resistance to climatic conditions. The downstream face of rockfill dams can be very steep, in fact as steep as 1 on 1, or even 1 on 3/4. On the other hand, the upstream face should be sloped not less than 1 on 3 or even flatter. This is not a requirement for stability, but mainly to allow the ice sheet to creep upon the face and to bring the aerated body of the rockfill upstream as far as possible, in order to raise the permafrost table (Fig. 2).

Earthfill Dams

Of the various types of earthfill dams, those that are wet or contain water are not suitable. This eliminates not only hydraulic-fill dams, but also those wherein the saturation line is inside the dam body (dams with a central core or a core wall). Actually, only dams with an upstream blanket (Fig. 3) are suitable for arctic conditions. Such dams can be kept dry throughout the year and are therefore not subject to freezing and swelling.

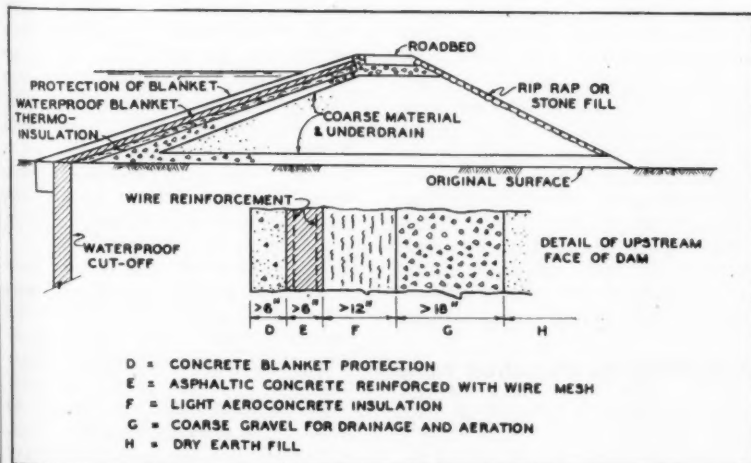


Fig. 3. Method of protecting dam.

The choice of material and its placing are simplified. Depending upon the earth in the borrow area, it may be necessary to screen the fill material and to use only sand larger than $\frac{1}{8}$ -in. Emphasis should be laid on the permeability of the fill material and the ease of draining it.

The waterproof blanket (E in Fig. 3) should be elastic enough to follow deformations induced by subsoil subsidence due to both thermic changes and loads. Therefore, a concrete blanket cannot be used, and the use of asphaltic or bituminous materials is indicated. To stabilize the blanket and provide it with higher resistance to deflections, it is advisable to place wire mesh reinforcing on both faces of the blanket. This can be applied either hot or cold. In choosing the materials, ductility is desirable. The thickness of the waterproofing blanket will depend on the height of the dam and the degree of anticipated settlement. A minimum blanket thickness of 6 in. is recommended, and the waterproofing should be properly secured to the dam to avoid slippage or displacement. Furthermore, the waterproofing blanket should be protected against wear by the ice sheet.

Blanket protection (D in Fig. 3) should be made of materials strong enough to resist severe wear. Precast concrete blocks, not less than 6 in. thick and made of high strength concrete (ultimate strength greater than 12,000 lb. per sq. in.), will serve the purpose. Such high-strength concrete blocks are possible only with proper materials and under closely controlled manufacturing conditions. Their value is increased by treating the water-side surface with vacuum finish. As in rockfill dams, the upstream face of the dam must be inclined more than usual.

Blanket protection can be made of cast-in-place concrete, but this requires form-work and complicates the control of materials and curing. However, if precast blocks are used, the question of their connections and ties is not simple to solve. Any upstream berms within the limits of the reservoir water fluctuations should be avoided to prevent accumulation of ice. In fact, it is advisable to avoid berms on the upstream face from about 10 ft. below the draw-down level to the top of the dam.

The thermo-insulation layer (F in Fig. 3) should protect the waterproofing blanket from transmission of cold from the dam body into the pool. Should this type of cooling of the blanket and the blanket protection occur, it would cause icing of the upstream face, with its concomitant expansion, and adfreezing forces

against the protective facing. The thermo-insulation layer can be used also as an equalizing base for the waterproof blanket. As such, it can equalize settlements and prevent puncturing of the waterproof blanket by the underlying coarse material. Insulation materials should be weather resistant, strong enough to withstand the hydraulic and dead load, and of low thermal conductivity. Because the insulation layer is covered by the blanket and the protective facing, it is quite inaccessible and any maintenance or replacement requires major repairs. Therefore, in choosing materials the question of permanency is decisive.

In regard to the strength of these insulation materials, the unit pressure due to water is comparatively low; for example, for a 100-ft. head this pressure amounts to only 43.2 lb. per sq. in. The dead load of blanket and protective facing contributes only an additional 1 lb. or 2 lb. per sq. in. Most of the materials likely to be used can resist such compressive stresses without appreciable deformations. If timber is used, it should be treated for weatherproofing. Solid materials (such as concrete, or brick masonry) require considerable thicknesses for the required insulation values.

On the other hand, inert materials of expanded type, such as light-weight concrete, afford economical insulation. The expanded materials can consist of either expanded aggregates, or of concrete expanded by admixtures. Materials made of dolomite, silica, slag, or glass fiber, are extremely effective and their cost at the construction site is the only deterrent to their use. The required thickness of insulation is determined by the severity of climatic conditions. The insulation layer should be sufficiently thick to reduce its conductivity coefficient to 0.02 or less. This would require that a layer of light-weight concrete be about 12 in. thick (Fig. 3). It is advisable to make the insulation flexible, so as to permit it to follow the settlements of the supporting dam body. If the insulation is made of inflexible materials, such as light-weight concrete, articulated precast slabs may be used; however, the upstream edges should be rounded or beveled to prevent damage to the waterproofing blanket.

Maintaining the Permafrost Table

To maintain the permafrost table high under the dam, it is necessary to insure low temperatures within the dam body. This can be accomplished by circulating cold air through the

dam during the winter season, thus undercooling the earth-fill sufficiently to prevent thawing during the summer. To afford this air circulation the dam should include either aeration ducts or pipes, or a coarse gravel layer (larger than 2-in.), which would permit passage of the air through it. Since a gravel layer is more resistant to settlement, and at the same time acts as a drainage system, gravel-type aeration appears preferable. A minimum thickness of 18 in. is suggested for the inclined gravel layer (G in Fig. 3), with the thickness increased toward the bottom of the slope. The base layer of gravel should be not less than 3 ft. thick. The inclined gravel layer should extend to the surface in order to have contact with the air. In summer, the top of the gravel layer can be covered so as to preserve the low temperature in the dam during the warm season. The same gravel layer can be used as a bottom layer under the earth fill, both for drainage and aeration purposes.

The downstream face of the dam should be protected against precipitation in order to keep the earth-fill dry, and also to protect the earth-fill from erosion. This is not a serious problem in the arctic because the rainfall is small. Seeding is not recommended because of the climatic conditions.

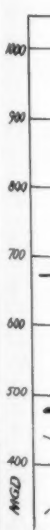
Spillway design and construction methods will be covered in the next installment.

Snow Removal by Flushing from Fire Hydrants

WHEN snow has stopped falling in Woodstown, N. J., the streets are plowed to within a few feet of the curb line. At the same time the merchants clean off their sidewalks. This leaves a large pile of snow adjacent to the curb. The inlets are diked so that water does not flow into them and the fire hydrants are turned on. This melts most of the snow and that which is not melted is allowed to become thoroughly saturated. Then, before the sidewalks are flooded, the catch basins are opened and the whole works allowed to flow away.

This system works at temperatures as low as 17 degrees and perhaps even lower, although there has been no occasion to work below that temperature. The minimum gutter grade required is about .25%, or three inches in 100 feet, just enough to allow a flow towards the inlets. It is, of course, necessary to have curbing to prevent the flow of water onto the sidewalk area.

THE plant serve and Uity of 18,000 reached operatioria certain and it to open treating and mcomin of the ppm, it was but b Coli v above The plant ent an ture s 2—C tion, velop trickl by a quire partn



Additions to the Princeton, N. J. Treatment Plant

I. RUSSELL RIKER

Borough Engineer

THE Princeton sewage treatment plant was constructed in 1932 to serve Princeton township, borough and University, with a design capacity of 2 mgd from a population of 18,000, which was expected to be reached by 1940. After 18 years of operation there appears to be no deterioration in the effluent, although certain units have become overloaded and it has been increasingly difficult to operate, particularly the units for treating and disposing of the sludge; and many mechanical units are becoming worn out. The average BOD of the final effluent for 1947 was 15.6 ppm, and that of the river receiving it was increased from 2.51 to 2.53, but both the 37° count and the B. Coli were less below the outlet than above.

The principal reasons why the plant still is delivering a good effluent are: 1—A liberal estimate of future sewage volume in designing it. 2—Careful maintenance and operation, utilizing the latest scientific developments. 3—Developments in trickling filter capacities, recognized by a 60% reduction in volume requirements of the State Health Department. However, some replace-

ments and enlargements are necessary, as noted further on.

The original treatment plant consisted of pumps lifting the sewage 77 ft.; settling tank; dosing tank; sprinkling filter; final settling tank; digestion tank; and glass-covered sludge drying beds. Chlorine is fed to both raw sewage and final effluent. (See PUBLIC WORKS for July 1941.) Later there were added a tank for treating supernatant, a mixing chamber between the filter and final settling tank where alum can be added, and a tower for mixing tin cans and chlorine water.

In planning the improvements needed, the first item was to estimate

the probable population and sewage flow in 1957. Due to wartime increase in population, we have no definite knowledge of the population served at the present time, but it is believed to consist of 14,000 in Princeton Borough and Township, 5,500 students in the University and school, including wives and families, and 2,000 transients; a total of 21,500. Population curves indicate that the Borough and Township population will increase to 16,500 by 1957, assuming that the curve will flatten to normal growth within the next 4 or 5 years. Assuming no change in the student and transient population, the total will be 23,000.

During the past two years the water consumption and sewage flow showed a very rapid increase, resulting from the increase in population. The sewage flow for the year 1945-46 exceeded 600 mg. If a sewage flow curve be plotted and projected similarly to the population curve, the estimated flow in 1957 would be 800 mg, or an average of 2,200,000 gpd. Allowance is being made for a maximum of 3 mgd, partly to allow for maximum infiltration of ground water, years of unusual rainfall having increased the flow by 50 mg above the normal.

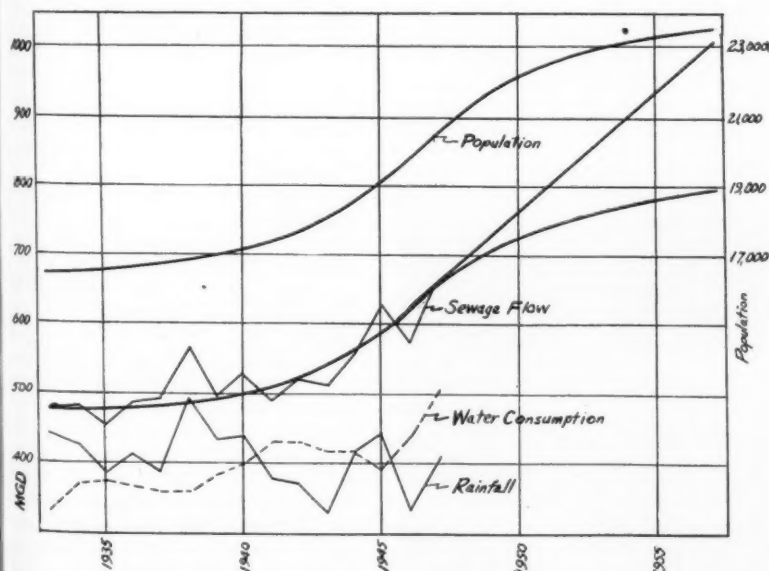
Pumps. The original pumping plant included a 1 mgd pump, a 2 mgd and a 4.5 mgd; also a gasoline operated generator which can supply sufficient current to operate all the pumps and the other plant equipment. In 1942 the 2 mgd pump was replaced by another of the same capacity, and the 1 mgd is to be replaced soon; both because they had worn out. The 1 mgd pump had operated

PRESENT AND PROPOSED CAPACITIES

Unit	Present Capacity	New Capacity
Pumping station	7 1/2 mil. gallons	7 1/2 mil. gallons
Settling tanks	2 mil. gallons	3 mil. gallons
Dosing tank	3 mil. gallons	3 mil. gallons
Stone filters	2 mil. gallons	5 mil. gallons
Final settling	2 mil. gallons	3 mil. gallons
Sludge digestion tank	18,000 persons *	25,000 persons
Sludge beds	18,000 *	27,000 "
Chlorine machine	One 150 lbs. and other	300 lbs. per 24 hours

* Maximum rate of flow; other units are for average flow.

* Theoretically, actually not enough for existing population.



Record of sewage flow, water consumption and rainfall, with projections for the future.

53,560 hr. and the 2 mgd pump 42,000 hr. without once clogging or causing any trouble, except that the check valve on the former had to be repaired last year. I think this speaks well for sewage pumps. The capacity of the pumps is ample for more than the estimated flow of 10 years hence.

The Treatment Plant

Settling Tank. This is a 2-compartment plain tank designed for 4 hr. detention, which will be increased 50% in capacity by adding a 3rd compartment.

Sprinkling Filters. There is one acre of stone, 8 ft. deep, designed for 2 mgd according to the 1930 rules of the State Health Dept. The first thought of the writer was to adapt these to the Bio-filtration or Aero-filtration system. However, the rules have been so modified as to permit treatment of 600,000 gal. per acre-foot, or 4,800,000 gpd on our 8 ft. bed. Also our filter has occasionally handled satisfactorily between 4 and 5 mgd for short periods. Enlargement therefore seems to be unnecessary for the filter or its dosing tank.

The final settling basin will have to be enlarged in the near future to provide one hour detention of the estimated future flow.

Digestion Tank. This has a capacity of 53,000 cu. ft. and is unheated. We get digestion only during May to October, and plan to install a heater for heating the sludge by a hot water system, or for heating the supernatant and returning it to the sludge tanks during the 6-month period when little digestion takes place. This should nearly double our digestion capacity.

Sludge Disposal

Sludge Beds. The area of the glass-covered sludge drying beds was 9,760 sq. ft. This was found to

be insufficient and in 1947 we added two open sand beds, each 40 x 120 ft., divided into five 24 x 40 ft. units. They were constructed according to the requirements of the New Jersey State Health Dept., with underdrains at the bottom in channels 10 feet apart, surrounded by 6" of stone and covered with 12" of stone graded from 1½" to ¾", with 6" of sand topping the bed. The outside banks of the two beds were given a slope of one to two. The partitions in each bed were constructed of 2" pre-cast concrete slabs 24" wide, the slab extending 12" in the ground and 12" out. The trenches for the underdrains were dug by a machine that discharged the excavated material into a truck operated alongside the machine. This work was done by the Borough by day labor for something less than \$10,000.

As the contemplated improvements are not being made under orders of the State Health Dept. we intend to spread them over a period of five years. Our plan for next year calls for installing a sludge-heating plant and new chlorine apparatus; followed by additions to the settling tanks the year following; then additions to the final settling tanks; and finally improvements to the filters and miscellaneous changes, including pumps for returning some of the effluent to the raw sewage.

Costs. The original plant and pumping station cost approximately \$230,000 which is being amortized over a twenty-five-year period. We decided to finance our five-year plan by borrowing the capital each year and amortizing it over a five year period, so that we add to our budget each year about \$2,000 for amortization and \$300 for interest. In this way the cost will not be too severe in any one year.

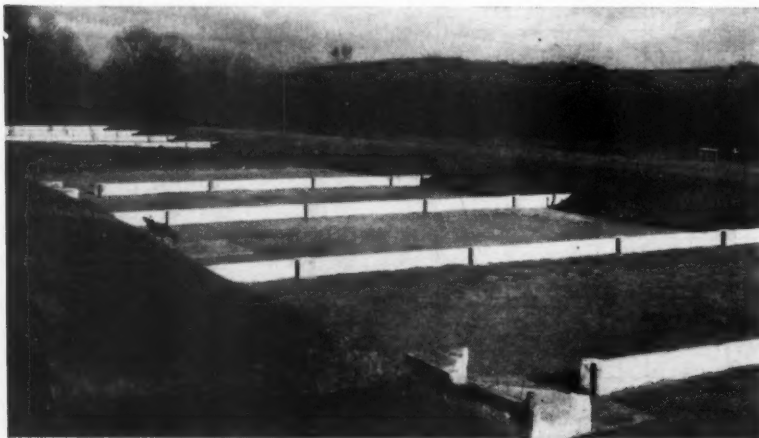
The cost of treating our sewage

per million gallons for operation is \$21.40, \$0.41 less than the average for the past ten years and much less than the original unit cost in 1933, which was \$23.00. Our total budget has increased about \$3,000, or fifteen per cent, since the plant was first operated. This program will perhaps increase it ten per cent more each year for the next five years. This we consider very reasonable, since most of our increase has been in salaries and wages. Savings have been made in chlorine costs, in water used for flushing, and in many smaller items so as to offset the higher costs due to inflation.

Aquatic Growths in Reservoirs

In the summer of 1947, aquatic growths became so abundant in Sheldon reservoir of the water system of Houston, Texas, that removal and control of them became absolutely necessary. The growths covered approximately 700 acres of the 2400 acres of the reservoir, and were quite thick in practically the whole 12 miles of the earthen canal, so obstructing the flow of water as to reduce seriously the storage capacity of the reservoir and endanger the important supply of raw water to several large industrial consumers along the canal. Investigation disclosed the emergent plants to be cattail, pond lily, water plantain, arrowhead, sedge and bamboo; the submerged plants to be pond weed and stonewort; and the floating, or surface, plants to be water shield and water lily. In addition, willows, coffee beans, rattle pods, tall indigo, and spurge were growing on the levees. Dr. Edgar C. Tullis of the United States Department of Agriculture identified these plants and recommended methods of eliminating them.

After rather extensive investigations of eradication processes, it was decided to spray the growths with the chemical weed killer 2,4-D. The reservoir proper was sprayed by plane and approximately 90% kill was obtained. The total cost for this work, including plane rental, was \$2.99 per acre. The canal was hand sprayed and approximately 50% kill effected. A second application to the canal was made by plane with results similar to those on the reservoir. Drag-line operation in progress at the end of the year showed the 2,4-D treatment to be successful in killing the 1947 crop; however, control measures will be required to eliminate future crops.



A view of the sludge drying beds.

Design Data on

FOREIGN AIRPORTS

DESCRPTIONS of several large overseas airports have been published in condensed form in *Aerodrome Abstracts*, a publication of the Road Research Laboratory and the British Air Ministry. The data on airport developments in India were prepared by E. H. Booth, and published in the *Journal of the Institution of Civil Engineers*, 1947, 29 (2); constructional features of the Lisbon Airport were described by E. Thomann in *Strasse u. Verkehr*, 1946, 32 (18/19); and the Canberra Airport was described in *Main Roads*, 1947, 12 (4).

Construction in India

In India, the war resulted in the construction of more than 200 aerodromes with 2,000-yd. runways. Tar, bitumen, and to some extent concrete also, were in short supply. The runways were mostly constructed from 4-in. slabs of 1:2½:5, or even 1:3:6 concrete on suitable bases. Although failures have occurred, the runways have been substantially successful with aircraft weighing up to 60,000 lb. and tire pressures of 60 lb. per sq. in. Failures have mostly been traced to the subgrades. "Drop walls" were found to be necessary round the perimeters of the pavements, to prevent the entry of water into the subgrade; for normal Indian conditions a minimum depth of 2 ft. below the under side of the pavement is required. Slabs were generally 33½ x 15 ft., with "cutaway" corners and butt joints precast with bitumen; ½-in. bitumen-filled expansion joints were placed at 100-ft. intervals. For many Indian soils it was necessary to insulate the pavement from the subsoil by a layer of 3-6 ins. of sand below the paving.

The Lisbon Airport

The Lisbon airport, first opened in 1942, has been so constructed that necessary extensions can be carried out without interference with existing arrangements. Lisbon is fortunate in having the Portela de Sacavim plateau, an ideal terrain for an air-

port, only a few kilometres to the north of the city centre. The Airport was first planned in 1938 by Portuguese engineers and Dutch specialists. In the first stage of development four 3,940 ft. (1,200-m.) runways were constructed, with provision for the extension of each to 6,560 ft. (2,000 m.). The total runway width is 820 ft. (250 m.), consisting of a central 164 ft. (50 m.) strip with a bituminous surface flanked on either side by a 328 ft. (100-m.) wide turfed strip. The subgrade is a fine-grained loamy sand having good bearing capacity when dry, but not when wet. Good drainage was therefore imperative, and a drainage system was installed, extending well beyond the actual limits of the flying field and consisting of 142,000 yd. (130,000 m.) of about 2½-in. (0.06-m.) diameter clay piping about 28 in. (0.7 m.) beneath the surface; this has proved fully effective. Bituminous surfacing was chosen for the runways on economic grounds and because of its shock-absorbing properties. This choice has justified itself and will be continued in future developments. The runway construction consists of a 10-in. (25-cm.) layer of sand resting on the loamy sand sub-base, covered by an 8-in. (20-cm.) layer of hand-placed stone pitching, then about 2 in. (5 cm.) of broken stone with a 2-in. (5-cm.) cover of fine macadam asphalt, which is subsequently to be covered with a ¾-in. (2-cm.) bituminous carpet. The surfacing has stood up well to heavy use, and passengers and pilots have both remarked that landings on it are almost free from shock. The apron area—about 23,920 sq. yd. (20,000 metres)—consists of concrete slabs 33 ft. x 16½ ft. x 6 in. (10 m. x 5 m. x 15 cm.). The projected extensions of the runways to a length of 6,560 ft. (2,000 m.) are already well under way.

Australian Practices

Work on the aerodrome at Canberra comprises the construction of two runways, one 7,000 ft. and the other 5,450 ft., about 2½ miles of

taxiways, a central hardstanding area (all from stabilized gravel), and extensive drainage works. Salient points of the design were:—maximum longitudinal grade on runways, 1%; crossfall of runways, 1%; crossfall of sidestrips, 0.5%-2.0%; width of runways, 150 ft.; thickness of pavement on runways, 12 in. (14 in. at ends); thickness of pavement on taxiways and hardstanding, 14 in.; width of taxiways, 40 ft.; bearing of 7,000 ft. runway, 170°; bearing of 5,450 ft. runway, 120°; maximum cut and fill for construction of runways, respectively 1.43 ft. and 3.40 ft. Quantities of the principal items of work were:—earthwork, 167,000 cu. yd.; pavement, 311,000 sq. yd.; cable ducts (4-in. diameter concrete pipes), 6,480 lin. ft.; pipe drains, 13,640 lin. ft.; concrete drains (grated), 6,700 lin. ft.; open drains, 9,500 lin. ft. For the collection of surface water a system of open drains was constructed, leading to sump inlets from which water was carried in underground pipe drains, varying from 9 to 48 in. diameter, to an adjacent watercourse.

The principal items of plant used were: 10 track-type tractors, 3 with bulldozer attachments; 7 cable-operated carryall scoops 8 to 11 cu. yd. capacity; 3 light and 1 medium pneumatic-tired tractors; 5 heavy-duty motor graders; 1 tractor-drawn heavy grader; 8 double-drum and 1 treble-drum sheepfoot rollers used in 3 sets; 3 pneumatic rollers; 3 6-8 ton smooth rollers; 6 water tanks for truck mounting, fitted with sprayer bar; 1 Barber-Greene trencher (for excavating pipe trenches); 1 ¾-cu.-yd. excavator, fitted as back-ditcher and used periodically as a crane. The pavement gravel was an altered shale with some quartzite and quartz in a matrix of loamy soil. It was used in its natural state for part of the work; when deficient in sand it was stabilized. The total quantities placed were 84,500 cu. yd. of gravel and 81,500 cu. yd. of sand. Consolidation of both subgrade and pavement was very thoroughly carried out; the compaction actually obtained averaged 90.9% for the subgrade and 97.9% for the pavement (% of the dry density by the Modified Proctor Density test—A.A.S.H.O. Method No. T99). A field laboratory was established at the aerodrome, and the number of compaction, mechanical analysis and other tests totalled 1,400. A two-weeks course of instruction, held for plant operators, resulted in a marked increase in output. The pavements were subsequently covered with a bituminous surfacing.

Removing Low Concentrations of Phenolic Compounds from Water*

Neuberne H. Brown, Jr., and Lewis B. Miller, Associate Professor, Dept. of Chemical Engineering, University of Cincinnati

METHODS that have been developed for the elimination of low concentrations of phenolic compounds from industrial wastes or from raw waters to be used for potable purposes are costly with respect to chemical or equipment requirements, or are dangerous and difficult to handle. In this investigation efforts were made to develop new chemical methods for removing or destroying very low concentrations of phenolic compounds from water solution, to improve existing methods, and to check the claims of other recent investigators.

The major points of the investigation are as follows:

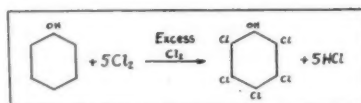
1. Adsorption of phenolic compounds by chemical flocculants. So far as is known, this method has not been attempted before. If removal of phenols could be attained by commercially feasible quantities of flocculant, both clarification and phenol removal could be accomplished in one operation.
2. Reaction of phenol with metallic salts to produce insoluble or non-reacting compounds which can be adsorbed. A complex ion salt is formed between phenol and ferric chloride in concentrated solutions. If this holds true for dilute solutions, adsorption of the iron-phenol complex by ferric hydroxide floc may be possible.
3. Reaction of phenols with organic reagents to form insoluble compounds, more readily adsorbed compounds, or compounds in which chlorination does not occur as readily as with the free phenols.
4. To find a feasible substitute for chlorine in water disinfection that will not accentuate the phenolic taste and odor. Investigation of oxidizing agents such as chlorine dioxide for destroying phenols, including attempts to develop simple and low-cost methods of producing it.

*Abstract of a "Dissertation for the degree of Master of Science submitted to the Graduate School of Arts and Sciences of the University of Cincinnati" by Neuberne H. Brown, Jr.

The Chemistry of Phenols

For reactions in concentrated solution, the chemistry of phenols is well defined, but very little is known of the chemistry involved where concentrations are measured in parts per billion, as is the case with water treatment.

Phenols are readily chlorinated and brominated.



Chamberlain (1) gives the above reaction of phenols with chlorine.

Most phenols are readily attacked by oxidizing agents. Cohen (2) states that phenols undergo oxidation readily in the presence of alkali by absorbing oxygen from the air to give quinone compounds which are less pronounced in their taste and odor characteristics.

The various reactions of phenol with other organic reagents, ie. esterification, replacement of hydroxyl group by amino-groups or alkyl radicals, require concentrated reactants, elevated temperatures, and some require elevated pressures. None of these would appear applicable to the water treatment field.

Attempted Methods of Removal

Oxidation is the ideal method of removal. For destroying phenol in wastes, where concentrations are high, oxidation utilizing aerobic bacteria as catalysts is by far the cheapest method; but careful control of phenol concentrations must be exercised as the antiseptic action will suppress the bacteria.

Phenols are rapidly oxidized in rivers and streams. However, under today's heavy load of pollutants, the available oxygen in the rivers and streams is insufficient to supply the great biochemical oxygen demand.

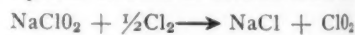
In an attempt to solve this problem, Harrison (7) in 1927 presented a method of super-chlorination in which a 20 to 1 ratio of chlorine to phenol was advocated. It was thought that this might produce a

less soluble compound or a quinone type compound. But the excess chlorine must be removed by use of sodium sulfite or other suitable method, making the total cost exceedingly high.

Marsh and Klingman (10) in 1941 developed a method of obtaining chlorophenol-free water by stepwise use of ammonia, activated carbon and excess chlorine. This method has many operating difficulties and has never attained wide commercial use.

At present most municipal water plants use activated carbon to adsorb the phenolic compounds from the raw waters, but the expense is great. The intensity of taste and odor determine the quantity of carbon required and this may vary from 1 to 500 pounds per million gallons of water treated.

Recently, investigators for Mathieson Alkali Works claim complete destruction of phenolic compounds in raw water by use of the powerful oxidizing agent, chlorine dioxide. The water is first chlorinated for disinfection and then treated with chlorine dioxide in the clear well. Chlorine dioxide is produced by the reaction of chlorine gas in an aqueous solution of sodium chlorite.



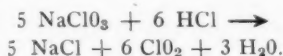
By virtue of its being explosive and difficult to handle, the chlorine dioxide gas must be produced in dilute quantities at the point of application and used immediately.

Experimental Results

Laboratory experiments were conducted to investigate the possibilities of the several methods of treatment suggested at the beginning of this article. The results and conclusions from these are given below.

Chlorine Dioxide. Because of the difficulties and dangers encountered in preparing chlorine dioxide from chlorine gas and sodium chlorite, other and more simple methods of preparing chlorine dioxide were studied, trying only methods which possessed commercial possibilities.

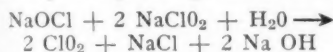
Several sources state that the following reaction holds true:



Ephraim (4) states that chlorine dioxide gas is "scarcely hydrolyzed" in water solution and that 20 volumes of gas exist as such in water at 0 degrees Centigrade. If this reaction is true for dilute solutions that are practical for water treatment, this will eliminate the necessity of handling chlorine gas for producing chlorine dioxide.

This reaction was tried for a range of 0.01 to 900 ppm calculated chlorine dioxide, but no destruction of phenol was observed. It was repeated adding sodium chloride in a sodium chloride-sodium chlorate ratio of 1 to 1, over a range of 0.5 to 400 ppm calculated chlorine dioxide, and no destruction of phenol was observed.

Lawrence (9) in an unpublished paper states that chlorine dioxide may be produced by hypochlorite ion activation of sodium chlorite in an alkaline medium with highest efficiency in a pH range of 8.5 to 9.0.



This method was tried, using a buffer of pH 8.8 for a calculated chlorine dioxide range of 0.020 to 50 ppm. The partial destruction of phenol was first noted at a concentration of 0.60 ppm calculated chlorine dioxide. Complete destruction of 100 parts per billion of phenol was observed at a calculated chlorine concentration of 10 ppm.

A taste test was conducted by impartial observers actually tasting the residual phenol which had been chlorinated by addition of excess sodium hypochlorite. The chlorophenol taste was reduced below threshold values on these samples of 100 parts per billion of phenol by 2 ppm calculated chlorine dioxide.

Destruction of the Gibbs reagent by any chlorine dioxide residual

might interfere with the accuracy of the determination of residual phenol where chlorine dioxide is being used; but careful experiments showed conclusively that the Gibbs reagent is not destroyed by any chlorine dioxide residual in the presence of residual phenol.

Ferric Chloride Complex Ion Formation. — A qualitative test for phenols is the blue coloration caused by the formation of a complex iron salt when ferric chloride is added to a phenolic solution. But where ferric chloride was being used to produce a floc of ferric hydroxide, no formation of this color was observed in 100 parts per billion phenol and ferric chloride over a range of 20 to 800 ppm., and no decrease in residual phenol was detected.

Flocculants. An extensive investigation of the mechanics of flocculation has been conducted and published by Miller (11, 12, 13). The experimental work indicated that the addition of basic ion to a flocculant such as alum did not always result in a precipitate of aluminum hydroxide as might be anticipated. The addition of the hydroxyl ion in a ratio up to 2.5 mols hydroxyl ion to 1 mol aluminum ion results in a precipitate of the composition $5(\text{Al}_2\text{O}_3) \cdot 3(\text{SO}_4)$. This compound has adsorption properties quite different from those of aluminum hydroxide. Further addition of the hydroxyl radical resulted in a change-over in the composition of the precipitate first to the hydroxide and, in excess of 3 to 1 formed the aluminate.

Work with mono, di, and tri-valent negative radicals showed that the lower valence radicals were readily displaced in the precipitate by the higher valence radicals. This principle seems to hold true for other flocculants such as ferric ion and the stannic ion. It was hoped that utilization of this phenomenon might serve

to adsorb phenolic compounds to a greater degree and result in their removal from raw water. Aluminum chloride was tried over a range of 100 to 800 ppm calculated floc, using ratios of 1, 2, 2.5, and 3 of hydroxyl ion to aluminum ion. The higher concentrations using the 1 to 3 ratio indicated a slight decrease in residual phenol. Similar experiments with alum produced identically the same results.

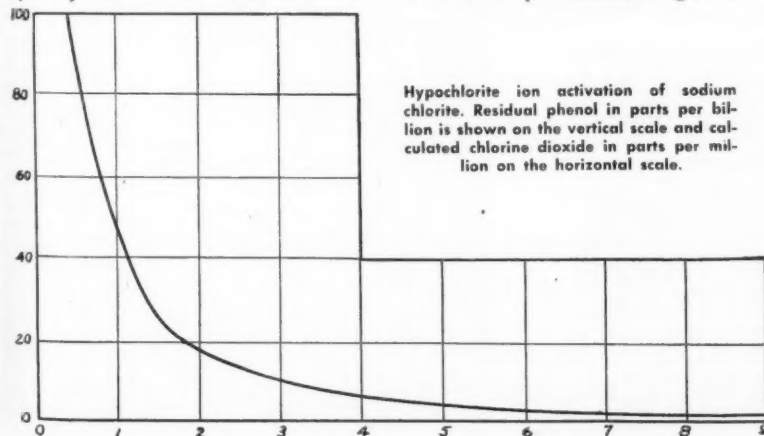
No increase or very slight ones were obtained by tests with ferric chloride, ferric sulfate and stannic chloride. Stannous chloride's strong reducing properties interfered with the Gibbs reagent, making its use impossible.

In brief, the results obtained from aluminum chloride, alum, iron and tin compounds seem to indicate a slight adsorption in very high concentrations, but this is of little practical importance because of the high cost of flocculants involved in water coagulation. The formation of the complex salt between iron and phenol evidently does not occur to an appreciable extent in concentrations as low as those encountered in water treatment. The investigation of the literature indicates little or no possibility of phenol in these low concentrations reacting with other organic reagents. In higher concentrations most reactions between phenol and other organic compounds require catalysts and conditions of temperature and pressure that would be impossible to duplicate in water treatment.

The possibility of using bromine as a substitute for chlorine in water disinfection has been investigated by Dow Chemical Company; but a bromophenol is produced which is more obnoxious in taste and odor than the chlorophenol.

The acid-chlorate method for preparation of chlorine dioxide does not hold for conditions as dilute as those encountered in the water conditioning field.

The results of hypochlorite ion activation of sodium chlorite as a source of chlorine dioxide indicates possible adaptation of this method for water treatment. The investigators for Mathieson Alkali Works state that 0.5 to 1.5 ppm of chlorine dioxide satisfactorily removes the chlorophenol taste and odor from water. Direct comparison of results was attempted but was found to be impossible since the Mathieson investigators do not mention the absolute quantity of phenol involved nor the residual phenol after treatment with various concentrations of chlorine dioxide. This investigation



indicated no decrease in residual phenol by calculated chlorine dioxide concentrations lower than 0.6 ppm. As the concentration of chlorine dioxide increased above 0.6 ppm, a rapid decrease in residual phenol was noted. At the calculated chlorine dioxide concentration of 2 ppm, no chlorophenol taste or odor was observed in a chlorinated phenol residual of 18 parts per billion. Treatment of 100 parts per billion phenol by 10 ppm calculated chlorine dioxide completely removed all traces of phenol as determined by chemical test.

The possible engineering applications of this method seem to be many, since both the chemicals and equipment required are already standard in the field of water treatment. This eliminates the danger of handling chlorine gas and keeps the chlorine dioxide in a dilute aqueous solution.

Summary

1. The use of flocculants for phenol removal has been found to be unsatisfactory because of the poor phenol reduction obtained even when large amounts of flocculant are used.

2. The complex iron salt formed by the reaction of phenol and ferric chloride does not occur to an ap-

preciable extent in the low concentrations typical of the water treatment field.

3. The investigation of the literature indicates the improbability that an organic reaction can be utilized in the removal of low concentrations of phenol from water.

4. The acid-chlorate method for producing chlorine dioxide was unsatisfactory under conditions of concentration which are obtained in water treatment.

5. The hypochlorite ion activation of sodium chlorite appears to have many commercial possibilities.

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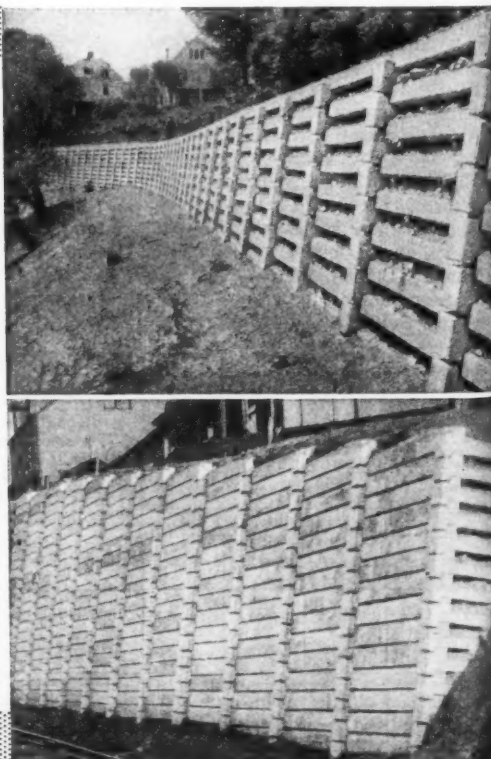
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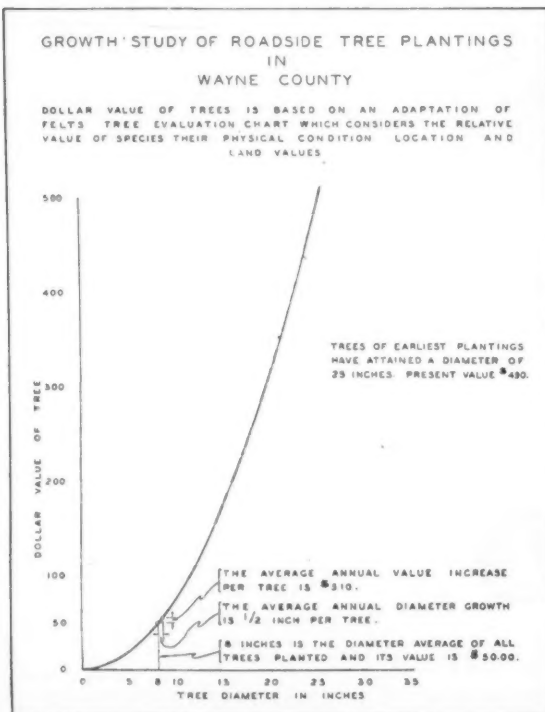
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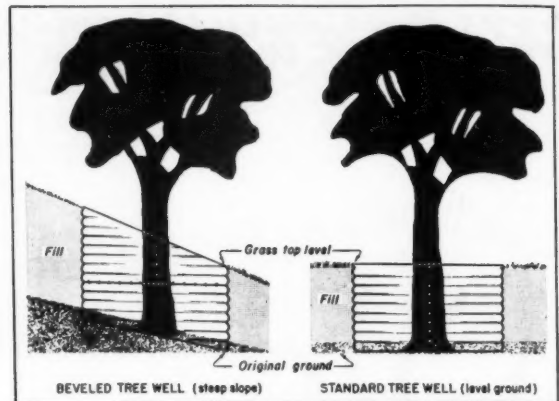
Tree Growth and Maintenance in Wayne County

Nearly 100,000 trees have been planted along the roadsides of Wayne County, Mich., in addition to more than 180,000 shrubs and nearly 4,000 evergreens. A growth study was made in 1947 in an attempt to evaluate the average tree for all roadside plantings. The annual growth in diameter was determined by means of borings to be approximately one-half inch. By means of the Felts tree evaluation chart, an annual increment of value of \$5.10 per tree was indicated. Applying this value to the trees now planted, the increase in value is nearly half a million dollars a year.

Several different types of asphalt emulsions were applied in 4-ft. circles around various species of trees and on various types of soils in an effort to develop methods for reducing the amount of labor required for cultivating newly planted trees. In this experimental



Tree evaluation chart.



Tree wells in place.

work, check trees were left with no treatment and complete records were maintained so that, in the future, it will be possible to determine which, if any, of the emulsions are toxic to the trees and whether the emulsion-penetrated soil will prevent weed growth without reducing normal tree growth.

Protecting Trees with a Metal Well

A prefabricated tree protecting well, made of galvanized corrugated metal, is shown in the accompanying illustration. This is made of two matching semi-circles, and installed by placing around the tree and bolting together. A rolled top edge gives extra rigidity. Wells are made by the United Steel Fabricators, Inc., Wooster, Ohio, to a standard height of 24 ins., but can be made to any required height, and in diameters from 36" to 84". Beveled sections can be used on hillside slopes, and where the slope is relatively flat the semi-circles can be offset up or down by one or more corrugations.

Price Trends in Highway Construction

ACCORDING to the Public Roads Administration, the cost of building roads continues to rise. Bid prices on common excavation, for the first quarter of 1948, averaged 43¢ per cubic yard, compared to 40¢ for the last quarter of 1947, 39¢ average for 1947, and 36¢ for 1946. This is 122.5% of the 1925-29 base. Bid prices on concrete pavement, during the first quarter of 1948, averaged \$3.34 per sq. yd., compared to \$3.38 in the preceding quarter, \$3.20 average for 1947, and \$2.78 average for 1946. The bid prices for the first quarter of 1948 are 150.6% of the 1925-29 base.

Bids on reinforcing steel reached 10¢ a pound in the first quarter of 1948, compared to an average of 9.3¢ in 1947 and 7.5¢ in 1946. Structural steel bid prices for the first quarter of 1948 were 14.5¢ per pound, considerably over twice the base price, and just 10% above the 1947 average. Structural concrete bid prices in the first quarter of this year averaged \$50.46 per cu. yd., compared to \$47.71 for the preceding quarter, \$45.84 average for 1947, and \$38.79 average for 1946.

On the basis of the composite mile of paving, bids received during the first quarter of this year showed a cost 150.5% above the 1925-29 base, compared with 140.4 average for 1947 and 122.9 average for 1946. The composite mile involves 17,491 cu. yds. of excavation, 3,726 sq. yds. of paving, 16,000 pounds of reinforcing steel, 4,325 pounds of structural steel and 68 cu. yds. of structural concrete.

Compaction of Soils by Various Types of Rollers

Tests have been made at the Road Research Laboratory, Harmondsworth, England, of the compaction of brick-earth and clayey gravel produced by two types of sheepsfoot roller, an 8-ton smooth-wheeled roller, and two types of pneumatic-tired roller. Main conclusions:—1. *Brick-earth*. With all the rollers tested the relative compaction of the soil increased rapidly during the first few passes, then at a decreasing rate with further passes until compaction remained constant: the number of passes beyond which no useful gain in relative compaction occurred was smaller for the smooth than for the sheepsfoot rollers. The club-foot sheepsfoot roller gave the best performance as regards (a) number of passes required to obtain relative compactions of 88 and 92 per cent and (b) percentage compacting efficiency after 8 and 16 passes; the ordinary pneumatic-tired roller came next in order of efficiency. Approximately 100 per cent relative compaction of the surface soil was obtained after 16 passes with any of the rollers, but the density decreased with depth at varying rates, depending on the type of roller used. The density of soil compacted with the pneumatic-tired and smooth-wheeled rollers was less variable than that compacted with the sheepsfoot rollers. II. *Clayey gravel*. Up to 32 passes the smooth-wheeled roller produced higher densities than the other rollers, but the densities produced by the sheepsfoot rollers were still increasing at 32 passes. The club-foot sheepsfoot roller gave better results than the tapered-foot sheepsfoot roller above 4 and up to 32 passes. The pneumatic-tired wobbly-wheel roller produced lower densities than the other types of rollers up to 12 passes; at 16 passes the densities produced by this roller and the two sheepsfoot rollers were approximately the same.—*Roads and Road Construction*.

Cost of Laying Water Pipe in Hartford

The annual report of the Water Bureau of Hartford, Conn., for the calendar year 1946, recently received, contains an analysis of the costs of laying water pipes. With trenching by machine, 1,179.5 ft. of 6" pipe cost, per foot, \$1.876 for labor, \$1.917 for materials, and \$0.465 for miscellaneous, a total of \$4.258 per ft. On 2,992 ft. of 6" pipe, on which trenching was furnished, the costs included 30.1¢ for labor and \$1.158 for materials, a total of \$1.459. On 18,760 ft. of 8", with machine trenching, costs were: Labor, \$1.139; materials, \$2.051; miscellaneous, 5.4¢; total \$3.244 per ft. On 15,091 ft. on which trenching was furnished, the total cost was \$2.226 per ft. With trenching by machine, 5,842 ft. of 10" cost \$4.469 per ft.; 7,746 ft. of 12" cost \$3.822 per ft.; and 813 ft. of 16" cost \$6.313 per ft. Labor costs were low on the 12", thus accounting for its lower average cost.

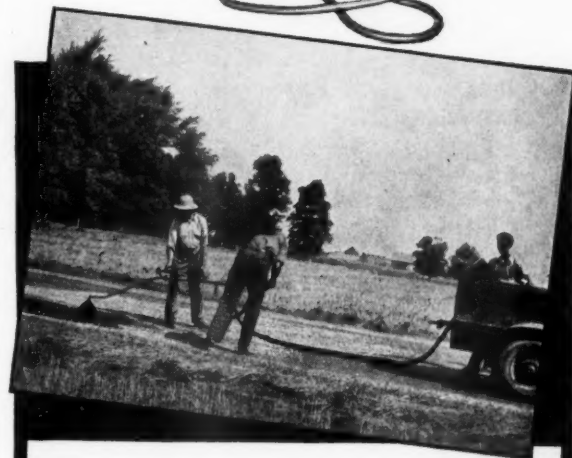
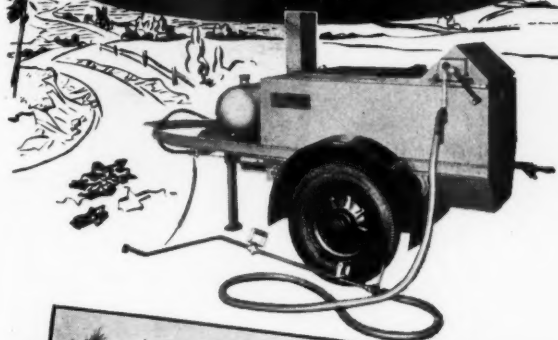
Laying 200 Feet of Pipe an Hour

GUAM experienced one of its worst sustained dry seasons during the first 6 months of 1947. Drastic conservation measures were imposed, but water hauling soon became necessary. As the water supply became more critical it was essential to find other sources. One was found in the Bonya River which emerges from the base of a cliff about a half mile below the Fena River Dam.

(Continued on page 46)

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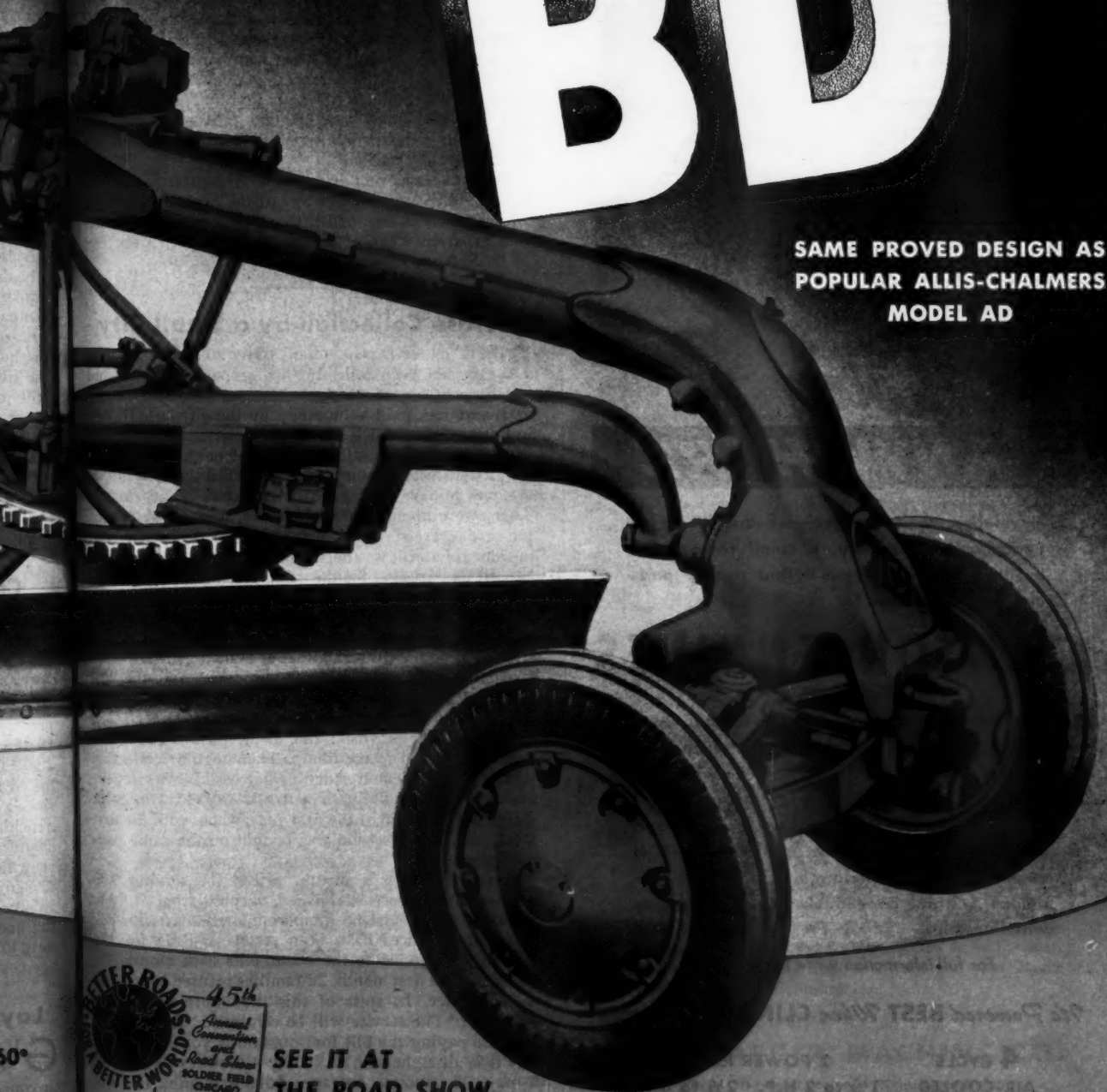
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(Continued from page 43)

The lucky find was made one morning in June and immediately explored by officers of Island Public Works and the 103d Naval Construction Battalion. Word was given to round up material and equipment and install a pipe line and pumps to pick up this water and deliver it to the intake pit at the Fena River Dam pumping station.

Planning was effected that same afternoon and field work started at 0700 the following morning. Approximately 2,500 feet of 6-inch spiral-weld pipe was laid through jungle growth over irregular terrain. In the absence of fittings, bends were improvised by heating the pipe with a welding torch flame and "wrinkling" the pipe. Two Chrysler trailer pumper units were spotted at the Bonya River bank and by 2000 that same day an additional flow of 400,000 gallons per day was realized at the Maanot Reservoir via the Fena River Dam pumping station.

With the exception of the Chief Shipfitter in charge, F. W. Hollis, the average age of the Seabees was only 19 years. These men had little or no previous construction experience except on-the-job training.—Courtesy of U. S. Navy Civil Engineer Corps Bulletin.

Refuse Collection by a Small City

ROCKY FORD, Colorado, a city of 3,500 population, has been collecting its garbage, rubbish and ashes since August, 1946, and financing the service by means of fees paid voluntarily by the citizens. Before initiating this service, the officials, with the Chamber of Commerce cooperating, had sent out cards asking the citizens whether they would be willing to pay 50 ct. a month to have their garbage collected by city forces. There were about 1,000 residences, and about 800 of the cards were returned, 650 stating that they favored the idea. (Later it was decided to collect all other refuse, as well as garbage, for the same fee, which caused approval of the service by most of those who had previously opposed it.) On the strength of this the city ordered a collecting truck to cost \$2,400, which was to be paid from the collection fees at \$200 a month.

An initial clean-up seemed desirable, and the Rotary and Lions Clubs donated \$200 for this purpose, citizens who owned trucks offered their use, and 150 men gave their services; and in three days 715 loads had been hauled to the dump. Then regular collection service was started. Residences get weekly service, the business district daily. The truck worked two 8-hr. shifts, until the end of the first year, when, with the first truck paid for, a second was bought on the same payment plan.

After operating a month, prices for serving 200 business places were established, varying from \$1.00 to \$10.00 a month, and no complaints or requests for adjustment of prices have been received. Bills for the service were added to the water bills each month. At the end of the first month, 22 families refused to pay the collection fee. In spite of this they were told (with a smile): "The service will be continued. Your neighbors are paying the bill for you, and if you like it that way it is all right with us." Only 4 families still refuse to pay. The income averages \$615 a month. The expenses are \$200 for payment on truck, \$320 wages for 2 men, and \$45 for gasoline and other expenses. The balance is set aside for new tires or repairs.

Garbage is sold to a hog feeder at \$30 a month, delivered. Other refuse is hauled 3 miles to a dump, which is managed by a man who lives on it and receives no

pay but sells materials picked from the rubbish. No rat has ever been seen at the dump.

During the summer months a pressure tank containing DDT is carried by the trucks, with a nozzle on each side of the truck, and every can is sprayed after being emptied. This is proving to be of great help in fly control.

The above is condensed from an article by Harry Barnes, City Engineer of Rocky Ford, in *Colorado Municipalities*.

Data From Illinois Sewage Plants

The Digester is issued quarterly by the Division of Sanitary Engineering of the Illinois Dept. of Public Health "to promote the installation and efficient operation of sewerage systems." It certainly does a good job, presenting an abundance of valuable information in an interesting manner. The following items of news from various Illinois plants are a few of those which appeared in the issue for the first quarter of 1948.

A workman constructing a manhole in a new sewer in the Urbana-Champaign district lighted a cigarette lighter in the manhole and flames shot out of the manhole for several seconds, seriously burning the man. The strange feature of this accident was that this was a new sewer, not connected to any other sewer and did not have sewage flowing through it. The only explanation seemed to be that the inflammable gas entered the sewer from the surrounding ground.

Last July the plant at De Kalb, Ill., received from 750,000 to 1,000,000 gpd of pea canning waste, which was two to three times as strong as the normal sewage. The average BOD during the month was 508 ppm, with a maximum of 670 ppm. In spite of this, the average BOD of the final effluent was 45 ppm. Fortunately there were available 19,380 sq. ft. of drying beds and good drying weather. The operator, Don Henn, used a flexible method of digester and storage, and recirculation through the trickling filter.

The Quincy plant was shut-down during June because of high water and no solids were pumped to the digester. During the first fifteen days the gas production fell from 19,000 cu. ft. per day to 5,000, and was only about 2,000 by the end of the month. The digester temperature meantime was held constant at 70°.

At Dixon, gas production fell from 10,000 cu. ft. per day in August to 2,500 by September. Investigation revealed that this was due to cyanide wastes from the plating operations of a local factory.

Reflector Beads for Virginia Highways

Virginia's State Highway Department is preparing to stripe 2,500 miles of main or heavily traveled highways with luminous glass-beaded white paint for night driving. Altogether, over 8,000 miles of primary highways will have traffic lines repainted this spring and summer, with nearly 5,000 miles receiving plain white and 2,500 miles reflectorized paint.

Almost 100,000 gallons of regulation white and 30,000 gallons of special paint to hold the glass beads will make bright new traffic lanes on almost the entire primary system.

Previously used only in isolated cases in Virginia, reflectorized marking this year is to cover some of the State's longest routes. U. S. 1, 11, 19, 29, 50 and 250 are some of the roads to be luminous striped throughout.



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Protection of Ground Water in Long Island

AS FAR back as 1933 the water table in Long Island, N. Y., was below sea level and the potability of ground water was being threatened by the inflow of sea water. To prevent further overdevelopment, the New York State Water Power and Control Commission now requires that water pumped from new wells for cooling and similar purposes be returned to the ground. During the summer of 1944, over 200 recharge wells and several recharge pits were returning water at the combined rate of approximately 60,000,000 gallons per day. There was also in operation several large recharge pits which return storm sewer runoff in Nassau County. The water is returned to the glacial beds from which most of it has been pumped, but in places it percolates into the underlying formations.

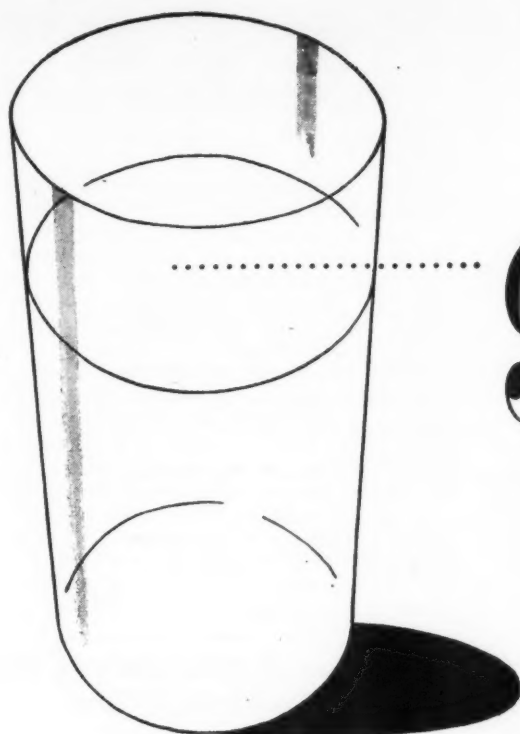
Well drillers have developed recharge wells capable of returning as much as 1,000 gallons per minute, many of them having been in operation for over 5 years without failing. Recharge pits in coarse glacial materials are capable of returning about 1,000,000 gallons per day per acre of exposed surface. The legal requirement that water pumped for cooling must be returned to the ground has caused a gradual decrease in the amount of ground water withdrawn, but an increase in actual use.

The Commission has carried out a number of investigations and tests in connection with the regulations and use of ground water in this area. As a general thing, Long Island is treated as a unit with careful distinction made as to the wells tapping the various aquifers, the situation being one of preventing further intrusion of salt water rather than one of control of use. As a matter of fact, wells of less than 100,000 gallons daily capacity when used for agricultural or irrigation purposes are exempt, as are wells for public water supplies.

The Commission has given intense study to the problem of recharging or diffusing clean water back into the formations from which it has been taken. Plans for all such installations are carefully scrutinized and checked for their feasibility. The Commission specifies the manner in which all approved projects shall be constructed, however, they assume no responsibility as far as results are concerned. This is for the reason that the technique of designing and construction diffusion wells is not too well known and a misinformed driller may get his client into trouble and a great deal of expense. The licensing of drillers on Long Island is now provided for in the Conservation Law.—From *Johnson National Drillers Journal*.

Parking Meter Experiences in Minnesota

Albert Lea collected \$1,095 from its 243 parking meters during the last two weeks of March. Collections are made weekly. *Brainerd*, with 400 meters, has been averaging about \$1,800 a month during the winter and \$2,750 a month during the summer. *Faribault's* collection from 450 meters was \$1,098 during the last two weeks of March. From December 1 until May 1 *Little Falls' 125* meters were "on vacation" and not enforced. Mayor George Merrick explained that opposition came directly from farm groups who said that either the city discontinue the meters or "we trade



good water

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...NOR ODOR**

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~~chlorinous compounds~~
~~algae~~
~~manganese~~
~~vegetation~~



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Day after day and year after year, Layne Well Water Systems continue to produce the 40 tons of water required in the making of each ton of paper. It is these same kind of well water systems that Layne builds for railroads, petroleum plants, packing houses, breweries, air conditioning installations, chemical plants, irrigation projects, municipalities—or in any situation where huge quantities of water must be produced at extremely low cost.

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elsewhere." The council recently voted to enforce the meters beginning May 1. *Northfield's* 265 meters have been bringing in an average bi-weekly collection of \$375 during the first three months of 1948.

Owatonna has all two-hour meters, 164 manual and 97 automatic, that have been operating since October 22. Total collections through March were \$7,791 or an average of about \$30 per meter. One man handles maintenance and collection on an hourly basis, \$1.50 per hour for maintenance and \$.90 per hour for collection. Maintenance costs have averaged about \$75 a month. Collection, one morning a week, costs about \$3.60. In a 17 weeks' period from December through March, *Red Wing's* 387 parking meters have collected a \$485 weekly average.

The *Rochester* council purchased 575 one and two-hour manual meters. The actual cost per meter was slightly more than \$65. Before the council let the contract, Acting Chief of Police A. M. Nelson conducted a series of tests on the competing meters to determine the effects caused by varying conditions of temperature and abuse. *Windom's* parking meter set-up is different from the larger cities. Two meters are located on each corner of the business district—a total of 40 automatic meters. Collections have been averaging about \$2 per meter month.—*Minnesota Municipalities.*

Operation of Milwaukee's Sewage Treatment Plant

JOHN E. HUBEL

The average sewage flow into Milwaukee's activated sludge sewage treatment plant, during 1947, was 138 mgd. Average removal of suspended solids was 85% and of bacteria 96%, a crystal clear effluent being discharged into Lake Michigan. During 1947, 52,681 tons of dried sludge were produced and sold under the name of Milorganite. The sludge as produced contains approximately 2% of solids; it is acidified, and then filtered on vacuum filters which reduce the moisture content to about 80%. It is then mixed with an equal amount of dry material and passed to rotary driers which reduce the moisture content to less than 5%. It is then screened, ground, and bagged for shipment. The net profits from the sale of the sludge are deducted from the operating and maintenance costs of the plant and sewers, and the remaining cost, about \$840,000 for 1947, is prorated to the various municipalities in the Metropolitan Sewerage District.

The Necessity for Planning Work

In commenting on a paving program, the Boston (Mass.) Finance Commission laid down a sound basis for public works, whether paving, water, sewerage or refuse is involved. Said the commission: "... There is more to successful paving work than following specifications. The framework of management within which such work is done must be sound. The conspicuous management defect which forms the point of departure for this report is the absence of a program. From this starting point runs a sequence of effects . . . which is startling: (1) A decision to appropriate money without any basis of need; (2) no opportunity for an adequate survey to determine type and quantity of work required; (3) resultant inaccurate estimates precluding intelligent bidding; (4) completion of work rendered impossible by lack of such estimates; and (5) jeopardizing the quality of the work by late starting."

PUBLIC WORKS DIGESTS

Sewerage

Water Supply

Highways and Airports

This section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each item refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Water Works Digest

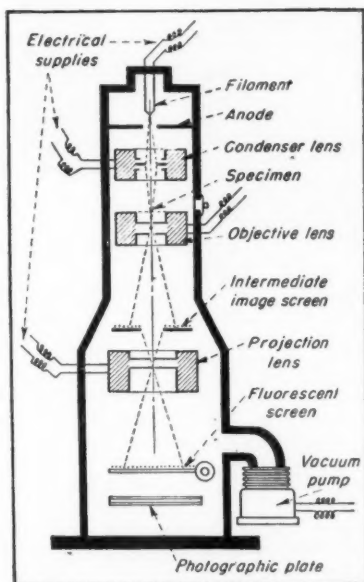
Electron Microscope For Identifying Bacteria

Research on identification of bacteria and microscopic organisms by use of the electron microscope is being carried out in the laboratory of Chicago's South District filtration plant. If coliform bacteria can be so identified, the time interval for determining presence of disease-producing organisms in water will be greatly shortened. Bacterial results by present testing procedures are so lengthy as to have little value in day to day operation. Electron micrographs of 5,000 diameters magnification can be enlarged by photography to 20,000-50,000 diameters, large enough to reveal shapes as well as other characteristics of bacteria.

The electron microscope consists of a source of irradiation, an anode, a specimen holder, a system of electronic lenses, an intermediate image screen, a fluorescent screen for visual observation, and a photographic plate for obtaining negatives of the image. These are all enclosed in an air-tight chamber and maintained under a high vacuum by a vacuum pump. The time required for starting the machine, mounting the specimen, making and developing a negative, and enlarging it is two to three hours. A particle 0.000,000,12 (120 billionths) of an inch is about the smallest that can be photographed.^{E11}

Liquid CO₂ for Recarbonation of Softened Water

The use of liquid carbon dioxide for recarbonation at the Minneapolis, Minn., softening plant gives about 98% absorption, as compared to 12 to 15% by conventional flue-gas or carbon dioxide producing systems. As practically all of the gas is absorbed, an exhaust system is not required to protect the health of plant operators.



Courtesy Engineering News-Record
Section of Electronic Microscope.

Also the cost of plant for applying the liquid dioxide is about a third of that of a conventional plant. The cost of the liquid, however, exceeds that of obtaining gas by burning. The liquid carbon dioxide is received in 24-ton tank cars. The plant consists of two rotary pumps, two 40-ton storage tanks, two vaporizers, two refrigerating units, a control panel, and headers and diffusers of porous hose. The pumps transfer the liquid from the tank car to the storage tanks, maintaining a pressure of 270 to 300 psi at a CO₂ temperature of about zero degrees F. When increased temperature raises the pressure to 325 psi, the refrigerating units is cut in automatically. The pressure is reduced to 20 psi before being

applied to the water through porous 1 1/2" hose.^{E16}

Calcining Sludge From a Softening Plant

Marshalltown, Ia., calcines the sludge from a lime-soda ash softening plant, producing lime for further softening at a cost of \$1.00 per ton less than the cost of commercial lime. A Bird centrifuge separates the calcium carbonate from the water, magnesium and iron impurities, which are discharged into a sewer. The carbonate cake, containing 40% moisture, is mixed with some pre-dried material and dropped into a Raymond flash-drying pan where 900° temperature is maintained; then blown to a vented cyclone where the steam and CO₂ escape into the air and the dried carbonate drops into a mechanical dry divider and that not needed for mixing with the wet carbonate is fed to a Pedersen calcining furnace, where it is pre-heated to 900° and calcined at 1800°. An 18 x 28 unit separates 1200 lb. of calcium carbonate per hr., dry basis. The process requires 75 to 80 gal. of No. 3 fuel oil per ton of lime produced when operating 9 hr. a day, or 70 to 75 gal. when operating 15 hr., and 100 kw of current per ton. The labor required is 4 hr. per ton, which could be reduced to 2 hr. if the plant was near enough to the softening plant so that one operator could manage both.^{J8}

Recalcining Carbonate Sludge

Plans have been prepared for recalcining the 28 tons per day of dry carbonate sludge solids to be produced by the proposed lime softening of 10 mgd of well water to 70 ppm of hardness at Pontiac, Mich. The three principal stages of operation are: (1) dewatering, classifying and rejecting the

greater portion of the magnesium and other impurities by means of continuous centrifuges; (2) flash drying; (3) recalcination by exposing the dried material to a temperature of approximately 1900° F.

In (1), carbonate slurry expected to contain approximately 15% solids will flow to two centrifuges which will produce cake of about 65% solids; which will be mixed with sufficient previously dried solids to prepare it for flash drying and calcining, which will be performed by either the Raymond or the Fluo Solids system. In the latter system, soda ash is added to the centrifuge cake before flash drying; and in the

calcining kiln, air is injected through the bed of pellets at the bottom to keep it in a fluid state and to preheat the air while cooling the finished lime. It is estimated that the centrifuges and calcining equipment will cost \$122,000, and piping, oil storage and building will bring the total cost to \$240,500; and that the operating cost per ton of CaO will be \$4.25 for oil, \$0.70 for power, \$1.50 for labor and \$1.50 for fixed plant charges.^{A45}

Two-Story Sedimentation

Long Beach, Calif., plans to construct this year a water treatment plant,

each of the 2 sedimentation basins of which is made with two stories. The total depth of water in the basin is 14'8", divided in two stories of equal depth by a horizontal floor. Water flows first through the lower story, then up and back through the upper one. Most of the sludge will be deposited in the lower, only a small amount of fine particles reaching the upper story; therefore sludge scrapers are provided for the lower one only, the upper one being cleaned during periodic shut-downs.^{E17}

Dams in Permafrost

Building of dams or reservoir embankments in northern regions where permafrost conditions exist requires consideration of subsoil peculiarities not found elsewhere. Water impounded in the reservoirs will thaw the permafrost for considerable depths and horizontal distances, causing subsidence of the ground. On the other hand, under the down-stream part of the embankment not reached by the water the protection from the air will cause the permafrost table to rise. In general, the following criteria must be satisfied:

- 1) The dam must be flexible enough to sustain considerable subsidences due to thawing of the ground.
- 2) The dam must be composed of materials that will convey but little heat from the atmosphere to the ground.
- 3) The dam must be composed of such materials and be of sufficient thickness that it will not convey cold to the water in the reservoir.
- 4) The main body of the dam must be kept dry, so as to resist freezing without damage.
- 5) The dam must be water tight under extreme variations of temperature (160°F).
- 6) The facing of the dam must resist severe ice thrust and wear.
- 7) The materials comprising the dam must, in themselves, resist severe climatic conditions.
- 8) The shear stresses in the soil must be kept at a minimum.^{P18}

Fighting Frazil Ice

During the past two winters frazil ice forming on the impellers of low-lift pumps at Chicago's South District filtration plant threatened to shut off the raw water supply from Lake Michigan on 36 occasions. This ice was composed of thin, perfectly round flat crystals which reached 4" in diameter and 1/32" thickness. They formed when the water temperature fell as little as 0.1° below 32°. Several methods of removing the ice proved effective—running the pump with the discharge valve closed; reversing the flow through the pump; stopping the pump for 15 to 30 minutes to let the room temperature thaw the ice; pumping 37° water into the intake basin. In the fall of 1946, means were installed for injecting steam into pump suction at



METER INSTALLATIONS WITH FORD YOKES

Rigid, constant spacing of the Ford Yoke makes meter setting and changing surprisingly easy. Inlet and outlet pipes are permanently connected and aligned even when meter has been removed. No dangerous yanking or twisting of pipes is ever necessary.

The simple expansion connection needs no wrenches yet makes a tight, trouble-free meter installation. When meter is removed, the expansion fitting stays with it, making water stealing quite impractical.

Ford Yokes are made in three types, Riser Yokes, Angle Yokes and Straight Line Yokes. All are equipped with proper fittings and gaskets. In ordinary usage, they last a lifetime.

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90-100 psi, which raised the water temperature 0.130° to 0.105° and precluded frazil ice clogging. Ice on the ports of the crib intake in the lake is best removed by electrically exploding $\frac{1}{4}$ to $\frac{1}{3}$ of a stick of dynamite in the water opposite the openings.^{E10}

Formulas for Flow in Pipes

After discussing at length the many formulas for pipe flow that have been used on proposed, their origin, and the results of flow tests, the author concludes that "Flow in the vicinity of the pipe walls, usually termed 'laminar flow', might also be called 'contact flow', while near the center the flow usually termed 'turbulent flow' may be called 'free flow.' Between the two is a transition zone with 'mixed flow'." The exponent of V should be 2 for free flow and 1 for contact flow; therefore, the greater the pipe area occupied by free flow (that is, the larger the pipe), the nearer should the exponent be to 2. For any one large pipe, the Darcy formula, once the coefficient has been determined, is more accurate than many other formulas. For most practical purposes, flow in large diameter pipes can best be expressed by the

formula $H = K \frac{V^2}{D^x}$, in which H

is loss of head in feet per 1,000. K is resistance coefficient, V is mean velocity, D is diameter of pipe, and x is between 1 and 1.25.^{G22}

Radio for the Water Department

Any water department operating 8 or more service vehicles can save money by use of radio. A department having less than three can not unless there exist very unusual conditions. For those between these two classifications in planning the installation of radio service there should be careful study and analysis of the potential gains and losses. Radio furnishes instant communication between the office and maintenance personnel in the field. This is of special importance in case of a broken main; it may reduce the valve closing time by as much as two-thirds and thus save possible property loss greater than the cost of radio would amount to in several years. Seattle, Wash., radio plant cost \$8,632 plus \$550 for each mobile unit. It is used by the water, light and transportation departments, which share the cost. The water department's overall cost of operation, including depreciation and obsolescence on stations and 9 mobile units, was \$2,973.54 in 1946.^{G23}

Increasing Rates, Improving Quality

The boast of water management should be the quality of its product, not the cheapness. Water is too cheap; possibly if consumers paid more for it they would have more respect for those who furnish it and pay them higher salaries;

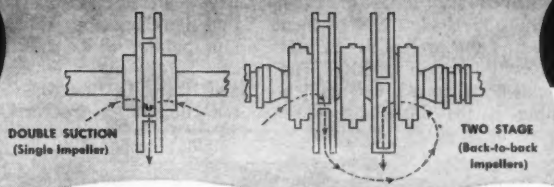
also would not waste so much. Possibly an added expenditure of \$2 to \$8 per mg would be necessary to remove all taste and odor; but what consumer would not cheerfully pay a fraction of a cent a day to be rid of taste and odor in the water he uses?

In some cases the improved quality can be obtained at little increase in cost by improving the efficiency of the personnel and of the equipment. Inefficiency in the average small plant and many large ones is due to politics, lack of qualifications by operators, not enough automatic equipment, and insufficient capacity of equipment. Lack of competition explains this to a considerable extent.

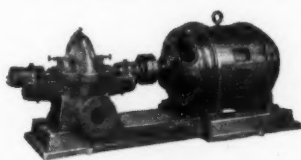
Few plant superintendents know accurately what their production costs are. The author presents a quiz list to enable each operator to learn how good he is. Condensed, the list and the score point for each of the ten items is as follows: Hardness below 135 ppm—6. Non-corrosive—10. No taste and odor complaints—20. Clear and sparkling—3. Plant and reservoirs kept clean—10. Water sterile—25. Membership in AWWA and luncheon clubs, and reading waterworks literature—10. Attendance at conventions—3. Activity in water works associations—2. Water rates sufficient to pay operating expenses and improvements and leave enough for expansion—10.^{F20}

PUMP with BALANCED POWER

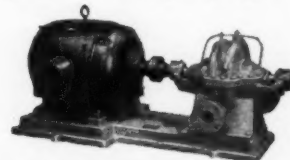
AMERICAN Double Suction and Two-Stage Centrifugal Pumps
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- The principle of balanced power . . . the equalization of hydraulic forces . . . which has been engineered into these two outstanding clear liquid pumps prevents motor power from being frittered away in costly and useless end-thrust. Horse power is devoted to the specific task of pumping!



Type 4000 Double Suction—For a wide range of applications in general water supply and clear liquid transfer. Split case, ball bearing design. Enclosed type, bronze, double suction impeller . . . with all water passages hand finished and exterior surfaces machined. Capacities from 50 to 7000 GPM. Heads from 25 to 250 feet. Bulletin No. 248.



Type 4400 Two Stage Single Suction—For water and clear liquid booster service. Split case, ball bearing design. Passage from first to second stage entirely within casing, reducing friction losses to a minimum. Back-to-back, single suction, bronze, enclosed type impellers. Capacities from 50 to 1500 GPM. Heads from 50 to 450 feet. Bulletin No. 246.

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Purification Without Coagulants

The author's experiences indicate that breakpoint chlorination, carbon, sand filtration, post-chlorination and corrosion control will give an acceptable, coliform-free product. Eliminating the use of a coagulant, except when necessary to lower turbidity and color, is practicable, reduces cost of alum and lime or soda ash for pH adjustment, and lengthens filter runs. "The days of trapping bacteria in a gelatinous floc are over." For raw waters of moderate turbidity it may be possible to eliminate the use of alum entirely for extended periods of time, at the same time maintaining highly satisfactory characteristics with respect to turbidity and color. There probably are in the water sufficient organic iron or other substances which require only oxidation treatment, as by super-chlorination, to render them effective either by oxidation, alteration of the inhibiting colloids, or a combination of both. ⁶²¹

Water Softening

The population served by softening plants in the United States in 1924 was 2,000,000; in 1941 it had reached 11,500,000, and the probability is that the number will increase rapidly. The argument chiefly advanced for municipal softening is the financial one of

the saving in cost of soap. Calculations of such savings based on soap costs in 1930 should be amended to allow for the increase of 80% in cost of soap in 1946. Also there has been considerable increase in the amount of soap used per capita. On the other hand, there is increasing use of synthetics as a substitute for or as part of soap products; and softening has no effect on the effectiveness of these. In 1947, 250 million pounds of these synthetics were sold, as compared to 2,320 million pounds of soap. ^{A29}

Chlorine Dioxide As a Bactericide

Chlorine dioxide has a high degree of reactivity with organic compounds. This causes it to combine with phenols, algae and other organic pollutants at the same time as, or even before, it attacks bacteria. Therefore, the more of such pollutants that are in a water, the more chlorine dioxide is required to produce bactericidal results. It reacts with organic compounds more rapidly than does chlorine; some of these compounds may come through the filter and not react with chlorine until they have entered the distribution system, thus lowering the residual at the distant points; while chlorine dioxide reacts before the water leaves the plant and there is therefore no subsequent reduction in the residual.

In brief, chlorine dioxide treatment often permits effective disinfection by prechlorination where it otherwise would be impossible; and makes it possible to maintain a residual to the ends of the distribution lines. It is an effective bactericide in all types of contaminated waters; even more efficient than chlorine where organic contamination is low, but is more expensive if used as a bactericide only. Its bactericidal action is stable with respect to pH and therefore it is especially valuable for waters with a high pH. About 65 cities in the United States are using chlorine dioxide but none primarily as a disinfecting agent. ^{B19}

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 39. Design Features of the Northeast Station Reservoir, Detroit. By Leo V. Garrity. Pp. 423-436.
 40. Public Water Supplies in Mississippi. By H. A. Kroeze. Pp. 437-440.
 41. Basic Water Problems in Florida. By A. G. Matthews. Pp. 441-444.
 42. Conservation and Control of Texas Water Resources. By E. V. Spence. Pp. 445-453.

Mueller Meter Box Covers and Mueller Meter Yokes are the ideal combination to provide the most adequate protection and yet give easy access to the meter. The Yoke serves as a permanent pipe fitting and maintains the correct spacing and alignment of pipe at all times whether the meter is in or out. The meter is never subjected to pipe strains as it is held in the yoke by means of an expansion fitting built in the yoke and can be removed in much less time than a meter installed with ordinary meter couplings. Mueller Meter Yokes are available in a number of various styles and types necessary to meet different kinds of installations.

Mueller Meter Box Covers protect the meter against accidental damage and tampering, yet afford easy access for reading, testing or changing. The lids have a special worm-type lock that is usually operated with a special 4-way Key that also serves as a handle. As the Key is turned, the worm forces the lid up, and in closing, it pulls the lid solidly against the cover and prevents the entrance of dirt and cold air. Mueller Meter Box Covers are made in two patterns—the "Regular" pattern with a non-recessed lid generally used for parking installations and the "Inset" pattern with a recessed lid generally used for installation in concrete.

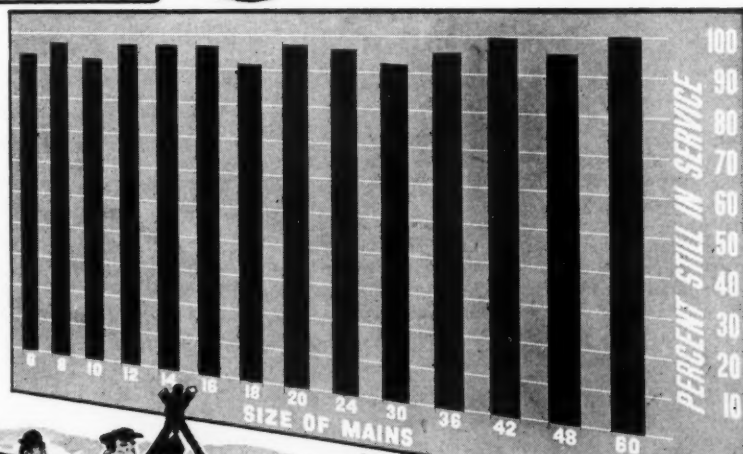
Both Mueller Meter Box Covers and Mueller Meter Yokes are available now. Write us concerning your requirements.

THE SAGA OF 50 MILLION FEET OF CAST IRON PIPE

In the 125 years since 1817, 25 cities had laid 50 million feet of cast iron water mains in sizes 6-inch and up. What had happened to those mains and to other facilities? A committee representing three water works organizations determined to find out. For these 25 cities, large and small, stretching from Canada to Florida, provided a representative cross-section of water service conditions generally. Facts developed could therefore be accepted as valid by all water works men. The survey was recently completed and the findings published by the American Water Works Association.

What happened to the 50 million feet of cast iron pipe? The saga is told by the chart. It shows that, of all the cast iron water mains ever laid in the 25 cities since 1817, in sizes 6-inch and up, 96% are still in service. This statement is based on facts secured by pipe users, from users, for users! Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 122 South Michigan Ave., Chicago 3, Ill.

96% STILL IN SERVICE



96% of all cast iron water mains* laid in these 25 cities over a period of 125 years is still in service.

Alexandria, Virginia
 Babylon, New York
 Clinton, Iowa
 Clyde, New York
 Denver, Colorado
 Des Moines, Iowa
 Detroit, Michigan
 Huntington, West Virginia
 Jamaica, New York
 Merrick, New York
 Norwich, New York
 Ottawa, Ontario
 Philadelphia, Pennsylvania
 Portland, Maine
 Rochester (Suburban), N. Y.
 St. Mary's, Pennsylvania
 St. Paul, Minnesota
 Sag Harbor, New York
 Scranton, Pennsylvania
 Springfield, Massachusetts
 Summit, New Jersey
 Syracuse (Suburban), N. Y.
 Utica, New York
 West Palm Beach, Florida
 Winnipeg, Manitoba

* Sizes from 6 to 60 inches.



CAST IRON PIPE SERVES FOR CENTURIES

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44. State Control of Louisiana Water Resources. By John E. Trygg. Pp. 457-460.
45. Pontiac Recalcining Plant. By Bernal H. Swab. Pp. 461-467.
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May

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48. Magnesium for Cathodic Protection of a Municipal Piping System. By K. D. Wahlquist and Oliver Osborn. Pp. 495-503.
49. Flushometer Valve Problems in Temporary Shut-Offs. By A. P. Bell and Wm. H. Cary, Jr. Pp. 504-508.
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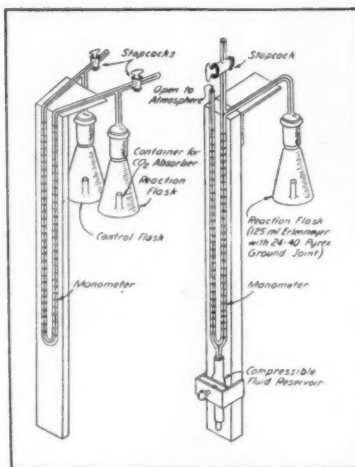
The Sewerage Digest

Manometric Measurement of B.O.D.

Manometric technique is widely used in microbiology and has been tried in sewage research, but little progress has been made in adapting it for routine use in sewage laboratories. The standard BOD test requires the use of several varying dilutions of the sample and an incubation period of five days; which objectionable features, and others, are overcome by the proposed manometric method. Instruments called respirometers are employed, of which four types are in use—the Haldane, Barcroft, Warburg, and Fenn. The Barcroft and Warburg types are recommended for sewage works laboratories; especially the Warburg, because of the relative ease and precision with which the several variables can be controlled. This comprises a reaction flask attached to a U-shaped capillary manometer, the other end of which is open to the atmosphere; a number of which flasks are used in conjunction with a single independent control flask and a manometer for barometric and temperature compensation. A measured volume of the undiluted sample is placed in the flask and it is connected to the manometer and a shaker. The fluid in the closed arm is adjusted to a constant level at the time of each reading, then the level of the fluid in the open arm is read and to it is added any change in atmospheric pressure, and the sum of these, multiplied by the flask constant, gives the weight or volume of the oxygen absorbed. Using undiluted samples with constant aeration and mixing, the rate of oxidation is greatly increased, and 24-hr. values at 25° C are approximately 75% of the standard 5-day values. For plant control purposes shorter incubation periods are possible.^{C24}

Biological Aspects Of Stream Pollution

The complex interactions resulting from stream pollution are predominantly biological. Living organisms are affected by the conditions of stream pollution. Their distribution is altered and may be used to complete the pollutional picture obtained by the usual testing procedures. Their activities contribute tremendously to stream recovery by using pollutants as a source of energy and growth material. Some eat bacteria and thus accelerate their biochemical activities. Green organisms supply oxygen so greatly needed for BOD satisfaction and sag curve elevation. Metabolic wastes, products and dead bodies are passed back to the stream as an altered link of a continuous chain. Biological efficiency in



Courtesy Sewage Works Journal

Differential and constant volume manometers.

the stream falls far short of that in the treatment plant. A good treatment plant would confine these activities and restore utility to the running stream.^{C30}

Oxidation of Waste Sulfite Liquor

Laboratory experimentations with concentrated waste sulfite liquor resulted in the development of an improved method of bringing the waste in contact with biological growth and the maintenance of a constant supply of oxygen in close proximity to the food and organisms.

Two types of treatment were studied. One, in which oxygen was supplied to

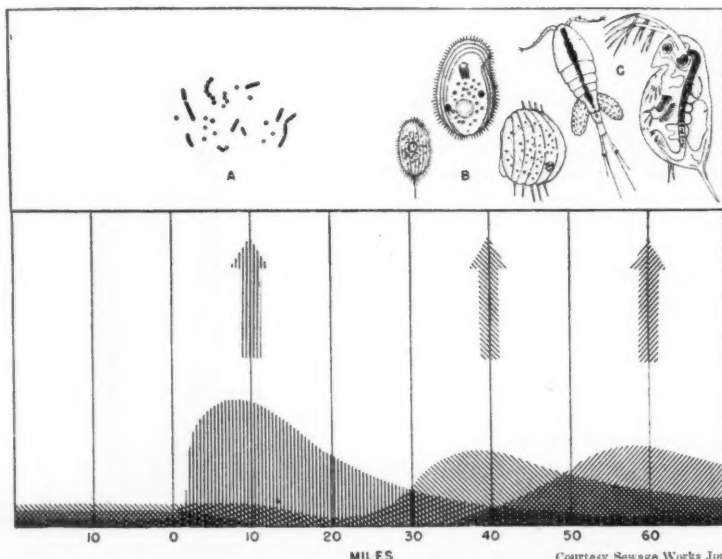
the liquid waste, either as air or as pure oxygen, was termed "liquid-phase treatment." The other, in which the supply of air used converted the sulfite liquor entirely to foam and in which attached growth developed, was termed "foam-phase treatment."

The following conclusions were drawn from the results of the work:

Treatment of sulfite liquor with compressed air and dispersed cells produces a stable foam, limits the quantity of oxygen necessary, and gives a BOD reduction not in excess of 30% in one day. Shaking sulfite liquor in the presence of pure oxygen with a mixed culture of dispersed cells gives a BOD reduction not exceeding 35%; the efficiency was not increased when pure cultures of *Torula utilis* and baker's yeast were substituted for mixed cultures. Foam-phase treatment with attached cultures gave 80 to 85% reduction in 24 hr. and nearly 50% in 6 hr.; only 60% with *Torula utilis* and 50% with baker's yeast.^{C29}

Chlorination At Sewage Plants

The author describes in some detail procedures for using chlorine for disinfection; as an adjunct to primary treatment for odor control, plant overload, grease removal, improving clarification, and decreasing the load on streams; as an adjunct to secondary treatment for trickling filter odor control, filter pooling control, filter fly control, and general filter improvement; and in activated sludge plants for control of sludge bulking and diffuser plate cleaning. As an adjunct to sludge dis-



Courtesy Sewage Works Journal

Linear alterations in populations of bacteria, ciliate protozoans and crustaceans.

posal it is used for control of foaming, chlorinating supernatant and waste activated sludge, and sludge thickening.

For disinfection, State board of health requirements range from 0.2 ppm residual after 5 min. contact to 1.0 ppm after 30 min. To satisfy the chlorine demand of raw sewage usually requires from 10 to 20 ppm; for secondary effluents, 6 to 12 ppm for trickling filters, 3 to 6 for sand filters, 2 to 4 for activated sludge; or 0.005 to 0.010 lb. per capita per day. For control of odor due to hydrogen sulphide, 20 to 25% of the chlorine demand of the sewage should be satisfied—in some cases 50%; up-sewer chlorination is strongly advised. Chlorination of sewage for any purpose reduces the BOD and hence the plant load. In applying solely for reducing the load, each ppm of chlorine reduces the BOD about 2 ppm; by the time a residual is produced, the BOD has been reduced 15 to 35%, and beyond this the amount of chlorine required is excessive. For grease removal, 2 to 5 ppm of prechlorination is sufficient. Chlorination sufficient to produce a residual in the stream receiving it will retard decomposition and tend to prevent anaerobic conditions during normally critical periods of rapid oxygen depletion, giving opportunity for reaeration. For controlling odors from trickling filter spray, chlorine to satisfy 10 to 20% of the demand usually suffices, but up to 100% is necessary in some cases. If the odor is from the bed itself, spreading chlorinated lime or hypochlorite over the surface, at about 10 lb. per 1,000 sq. ft., has been satisfactory. For controlling filter pooling, either method may be used, 8 to 12 lb. of hypochlorite per 1,000 sq. ft., or 2 to 10 ppm residual at the nozzles. For fly control, 3 to 10 ppm residual at the nozzle is usually required. For control of sludge bulking, applying 2 to 8 lb. of chlorine per 100,000 gal. of returned sludge at least two minutes ahead of where it mixes with the primary effluent is generally satisfactory. For control of foaming at Imhoff tanks, 3 to 15 ppm applied ahead of the tank is usually successful. For sufficiently reducing the load on a primary tank caused by returning supernatant to the influent, 20 to 80 ppm of chlorine added to the supernatant usually suffices. In concentrating sludge in thickening tanks, bulking has been avoided and water content reduced to 95% by maintaining 1 ppm residual in the clear liquid above the sludge.^{C31}

University of Florida Pilot Treatment Plant

Conditions in Florida affecting sewage treatment differ in several respects from those further north. In winter, the season of maximum flows, temperatures are considerably higher and more uniform; there are less industrial wastes; and due to the flat topography, the sewage is older when it reaches the plant. When post war influx of students necessitated enlarging the State Uni-

versity's sewage treatment plant, it was decided to so design this that it could be used as a pilot plant for studying the devices and methods most suitable for Florida towns. Fortunately the number of college personnel contributing the sewage, 7,000, was very nearly the average of the populations of the urban communities of the State. The plant was designed for a winter flow of about 700,000 gpd and a summer flow of 1,000,000. To permit efficient operation, the primary and secondary clarifiers were each made in three units, designed for 100,000, 200,000 and 400,000 gpd respectively, providing for any multiple of 100,000. Each of the two trickling filters, one standard rate and

one high rate, is designed to treat 350,000 gpd, one at 300 lb. of BOD per acre-foot and the other at 2500 lb. The plant, which was described briefly in the *Sewerage Digest* for November 1947, was placed in operation during that month.^{H27}

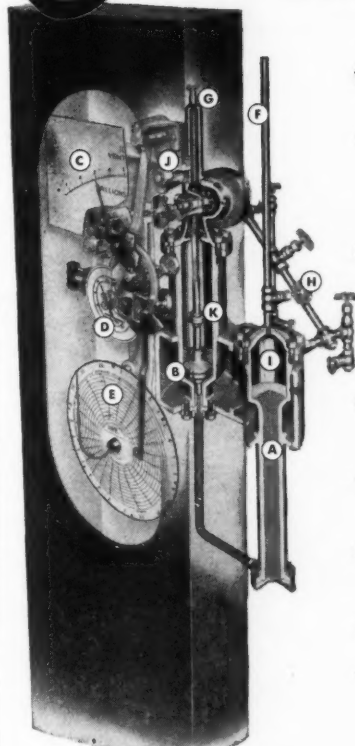
Sludge Disposal Proposed for Houston, Texas

Since 1916 Houston has been disposing of its primary and excess activated sludge by lagooning, part of the latter having been dried and sold for fertilizer since 1921. With the recently completed Simms Bayou activated sludge plant it seemed desirable to make

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Accuracy of registration easily and quickly checked in the field by means of built-in water head test pipe (F).

4. UNAFFECTED BY TRAPPED AIR:

Trapped air has no effect on accuracy; air easily removed through a valve at the top of each well (G and H).

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Mercury wells (I), main bracket on which mechanism and wells are mounted (J), and float (B) are high-tensile MEEHANITE iron.

6. HIGH ACCURACY — WIDE RANGE:

Registration with plus or minus 1% (response to differential induced by actual flow rate) over range of 100% to 5 1/2% capacity for Model MDUA; within plus or minus 1/2% from 100% to 50% and within plus or minus 1% from 50% to 5% of capacity for Model MDUAX.

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Check valve (K) prevents loss of mercury even at extreme overload differentials.

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Instruments

a study of the method most suitable for the disposal of all the city's sludge for the future up to 1970. It is estimated that by that time the population will be 776,810, sewage flow 68 mgd, and suspended solids in the excess activated sludge 70.88 tons per day. Engineers Greeley & Hansen and J. G. Turney were engaged to report on this subject.

Eleven different methods were investigated, six for disposing of raw sludge and five of digested. The methods studied for raw sludge were: Dewatering and hauling sludge cake to disposal area. Dewatering and drying and sale for fertilizer. Dewatering and incineration. Lagooning. Barging to the Gulf. Dewatering and drying about

61 tons of dry solids a day and disposing of excess sludge (averaging 10 tons) in lagoons. For digested sludge the methods were the same with the omission of the last. Revenue from the sale of dried sludge for fertilizer was estimated to bring \$12.25 a ton. (Houston sold it as high as \$17.25 in 1947). Gas from digestion was estimated to be worth 6 cts. per 1,000 cu. ft., yielding an average of \$9,500 a year. The various methods were compared on the basis of net annual cost, including operating and debt service.

Digesting the sludge added considerably to the net cost and was rejected. Of the raw sludge methods, dewatering and drying was estimated to cost \$83,330 annually; but modified by lagooning

a part, the cost was estimated at \$57,420, as it permitted considerable reduction in the cost of the drying plant. The annual cost of lagooning all the sludge was estimated to be \$100,550. The combined drying and lagooning was recommended if the city is prepared to enter the more or less uncertain business of manufacturing fertilizer; otherwise, lagooning is recommended.^{E16}

Diversion Factors For Combined Sewers

Several sanitary engineers discussed an article published last November under this heading and abstracted in *Sewerage Digest* for January. All criticized the method proposed for calculating diversion factors, there being general agreement that:

(1) Bacterial pollution is of greater significance than BOD passed into streams during overflow periods, "since even a small short-time overflow grossly pollutes the river, whereas a small short-time overflow has little effect upon BOD in the stream."

(2) Peak dry-weather flows should be considered, for they may be two to four times the average dry-weather flow.

(3) The degree of purification effected by the treatment plant should be included in an analysis of this type; apparently the method proposed does not allow for any BOD contributed to the stream by the effluent from the treatment plant.

(4) The refinement in calculation may not be justified by the accuracy of measurable factors and the influence of immeasurable variables. The choice of assumptions on which to base the calculation may introduce more error into the calculated diversion factor than would an assumption of the factor itself based on past experience.^{E15}

Sewerage Project For Portland, Oregon

Portland, Ore., lies on both sides of the Willamette river and south of Columbia Slough, and discharges combined sewage into the former through 50 sewers and into the Slough through 11 sewers. The Willamette river is highly polluted when it reaches the city, its dissolved oxygen content being, in 1944, only 10% of saturation before it received any of Portland's sewage. For 25 years the need for improving this condition has been increasingly recognized, and in 1944 consulting engineers were employed to prepare plans, to be carried out by a board of engineers. The design of the project is now nearing completion.

The logical solution seemed to be the construction of intercepting sewers paralleling both sides of the river and the slough to intercept the dry-weather flow of all the sewers near their outlets. However, an interceptor close to the river would require construction below river level in old sloughs filled with sawdust, slabwood, brickbats and miscellaneous debris, and

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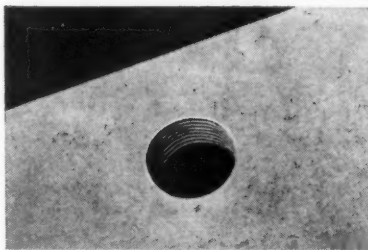
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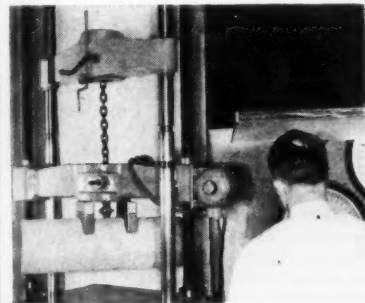
One of the many practical features of Transite* Pressure Pipe is the ease with which it may be tapped for service connections. Proof of this is evident in the hundreds of thousands of corporation stops which, over the years, have been inserted in Transite water mains. Year after year, these installations continue to serve their communities with efficiency and economy.



As this photograph shows, Transite Pipe takes clean, sharp threads. Strong and firm, these provide perfect seating for the threads of the corporation stop, assuring a watertight service connection.

developed and are available from leading manufacturers. Field experience shows that these special drills and taps remain sharp after prolonged use and are more economical than standard tools.

As is true with any tapped connection, maximum strength is obtained by engaging the greatest possible number of threads of the corporation



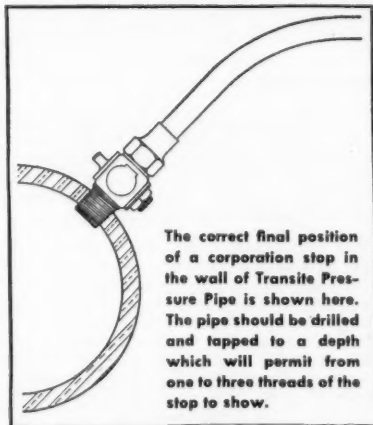
Laboratory tests demonstrate the strength of service connections made in Transite Pressure Pipe. In a recent series of such tests made on 8" Class 150 pipe, it required an average force of 4360 pounds to pull a 3/4" corporation stop from the pipe.

Transite Pipe can be tapped wet or dry; standard tapping machines are used. The special asbestos-cement composition which gives Transite its toughness and durability also provides excellent threading properties. The threads are sharp, clean and strong. Service connections are tight and lasting.

To facilitate tapping and insertion of the corporation stop, the use of a

lubricant such as graphite and oil on the tap and the threads of the stop is recommended.

Taps may be made with either Corporation Stop threads or Iron Pipe threads. While the standard combined drills and taps may be used, special alloy ones have been



The correct final position of a corporation stop in the wall of Transite Pressure Pipe is shown here. The pipe should be drilled and tapped to a depth which will permit from one to three threads of the stop to show.



Transite Pressure Pipe is readily tapped with standard tapping equipment. Here the combination drill and tap is about to be inserted in the tapping machine.

stop in the pipe wall. With Transite Pipe, this means that after the pipe wall has been properly drilled and tapped and the corporation stop fully inserted, from one to three threads of the stop will show.

Additional engineering data relating to service connections will appear in a future advertisement in this series. For further information, address Johns-Manville, Box 290, New York 16, N. Y.

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pumping of all the intercepted sewage. To avoid this, main interceptors are so located that all the sewage reaching them on the north side of the city can be carried by gravity to a treatment plant on Columbia Slough at the north-west limit of the city, and all on the south side will flow by gravity to a main pumping station, which lifts this sewage against a 45 to 56 ft. dynamic head into the north side interceptor. Several other short interceptors near the sewer outlets receive sewage from below the gravity interceptors, which is pumped into the latter by 12 small automatic pumping plants. The maximum volume of sewage to be pumped

is estimated to be 118 mgd, of which 7.2 mgd is pumped twice; and 57 mgd will flow by gravity to the treatment plant.

With so many sewers to be intercepted, the design of the diversion devices used is important. No known diversion device is designed to prevent grit from entering the interceptor, and a new type was developed in a local hydraulic laboratory. This consists of a horizontal orifice at the same elevation as the sewer invert but in a small chamber extending from the side of the sewer and separated from it by a long lip whose crest is 1/12 the sewer diameter above the invert. A dam

below the interceptor backs up the sewage to flow over this lip into the interceptor; but storm flow rises above this dam and flows to the river, taking with it any grit which has accumulated since the previous storm.

The effluent from the treatment plant will be discharged into the Columbia river, the minimum flow of which is 75,000 cfs, giving very high dilution; but it seems desirable to give the sewage primary treatment to remove floating material and a reasonable proportion of the settleable solids. The sewage will be passed through mechanically cleaned bar screens with 1" openings, grit channels and sedimentation basins, and the sludge is to be digested in four 90-ft. diameter digesters, the sludge being preheated by steam on its way to the digesters. For the early periods of operation the digested sludge will be mixed with the effluent and discharged into the Columbia river. The effect of this will be studied to learn its efficiency and desirability.^{C23}

Settling Tank Detention Period

Where primary settling tanks are followed by trickling filters, economy in designing requires a consideration of the relative construction costs of tanks and filters. Within limits, the longer the settling period the smaller can the filter area be made to produce a given effluent quality, and vice versa. Study of costs of a number of trickling filter plants show that the costs of primary settling basins are approximately 8% of the total plant costs while the trickling filters average 45% of the total cost. If, by increasing the detention period 50%, from two hours to three hours, the B.O.D. removal may be increased from 30% to 40%, the filter medium volume would be decreased by approximately 14%. The increased costs on the settling tank should not exceed 25% and the decreased cost of filters would approximate 11%. Thus, using \$1,000,000 total plant cost, this would represent a saving of approximately \$30,000, or 3% of the total cost.^{H23}

Warm Wall Sludge Digesters

Plans have been prepared for building, at the treatment plant of Raton, N. M., a digester 35 ft. in diameter and 30 ft. deep, an unusual feature of which is the heating system. It will be insulated above ground by means of rock wool, bats 4" thick between 2 x 4 studs and secured in place with wire and the whole covered with a coat of stucco. It is designed for 11,000 population and estimated that 1,260 lb. of dry solids will be added to the digester daily in sludge with 95% moisture. Assuming sludge temperature of 45°, to be raised to 95°, then 1,260,000 Btu will be required daily, or 52,400 per hour. Heat losses are calculated at 35,500 Btu through the floating cover, 10,000 through the walls above ground and 11,000 through the



Figure 450 Flame Trap Assembly—Consists of Flame Arrestor and Thermally Operated Shut-Off Valve. Installed in straight-pipeline flow. No expensive fittings necessary. Self-contained simple and foolproof. Fusible element melts at 200° F. and stops gas flow within 15 seconds. Shut-Off Valve cannot close unless contacted by flame.

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floor and wall below ground; giving a maximum heat requirement of 103,900 Btu. It is planned to supply this by heating the walls instead of by hot water coils inside the tank. The walls afford a heating surface of 3,300 sq. ft., whereas six turns of 3" metal pipe coils give only 1,350 sq. ft. Moreover, the pipes lose effectiveness with use by the baking of sludge on them, and the high temperature may kill the desirable bacteria. With six times the area, the temperature of the wall need not be as high as that of the pipes, and better, more uniform sludge is expected to result.^{H32}

Ice on Filters

The sewage treatment plant of Winnetka, S. D., contains two trickling filters of 60 ft. diameter, with rotary distributors. During the winter of 1947-48 heavy coatings of ice formed on the filters and the relative stability of the effluent dropped from an average of 98% to 35%-40%. On one occasion with the air temperature at 20° and wind velocity at 35 miles per hour, ice began to form; but a few hours later, with the air at zero and no wind, the ice melted completely. During this time the filter influent varied from 40° to 47°. Observation throughout the winter confirmed the idea that the formation of ice when the air was below 30° was dependent almost entirely on wind velocity. They plan installing a 5 ft. railing around the filters and fasten a canvas curtain on it in the winter.^{H31}


Financing Sewerage Improvements

Water rates are charges for services rendered in treating and delivering water to the consumers, not for the water itself. Sewer charges, similarly, are for services rendered in removing the same water after it has been used, and giving it treatment required by law or sanitary considerations. What is legal for the former is for the latter also. Court decisions have held that such charges are not taxes or assessments but are charges for services rendered. The most equitable basis for service rendered would seem to be the quantity of water delivered and removed. The Florida Supreme Court has held that "If no constitutional rights of the owner or occupant of premises are violated by shutting off the water for non-payment of the water bill, no such right will be violated by shutting off the water for non-payment of the bill for use of the sewage disposal system." Requiring owners who already have septic tanks to connect to a public sewer might be legally defensible as a measure of public health in some cases but not in others.^{G16}

Experiments in Bio-Precipitation

Experiments were begun in 1947 at the Harvard Graduate School of Engineering on a process suggested by

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Malcolm Pirnie to which the name "bio-precipitation" has been given. In this process, all the oxygen required is carried in by pre-oxygenated sewage; sewage being able to contain 5 times as much oxygen gas as it can oxygen in air. If this amount—45 ppm—is insufficient to meet the oxygen requirements, some of the effluent is recirculated. Use of pure oxygen promotes efficient gas transfer, and the high oxygen gradient enables the oxygen to penetrate more deeply into the floc particles. Separate final sedimentation facilities are not required. The experiments show that, for 90% purification, the bio-precipitation process can be loaded about 4 times more heavily than the conventional activated sludge. The cost of oxygen at \$4 per ton is about equal to the cost of compressing air at 1 ct. per kwh. These conclusions are from tests in a laboratory plant. Construction of a pilot plant to confirm them is proposed.¹³

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31. Canvas Wind Breaker to Control Filter Ice. By Clayton B. Madison. Pp. 245-246, 270.
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33. Four Ways to Control Interstate Pollution. Pp. 249-250.
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37. Performance of Final Settling Tanks. By Morris M. Cohn. Pp. 258-259, 264.
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18. Richmond-Sunset Sewage Treatment Plant Operation. Pp. 20-21.
19. Small Sewage Treatment Plants: Activated Sludge. Pp. 26-27, 40.
20. Bulk Refuse Collectors Help in Keeping Boston Clean. Pp. 33-34.

Sludge Gas Safety Equipment.—This helpful technical catalog shows a complete line of safety equipment for sludge digesters, including flame traps, pressure relief valves with waste gas flame traps, waste gas burners, gas pressure indicating gauges, drip traps and other equipment. It also shows a typical gas piping arrangement and gives data on size selection. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.

Waterproofing Concrete.—Hydopel, a product of the American Bitumuls Co., 200 Bush St., San Francisco, Calif., is an aqueous suspension of colloidal asphalt developed for use in waterproofing concrete. It is added at the rate of 1½ gals. per sack of cement. It reduces water absorption, with subsequent expansion and contraction; it improves dispersion and affords protection against alkaline or neutral salts or gases. It adds to workability. A complete booklet is available from the manufacturer at the above address.



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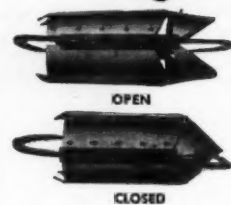
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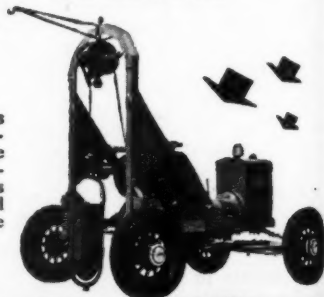
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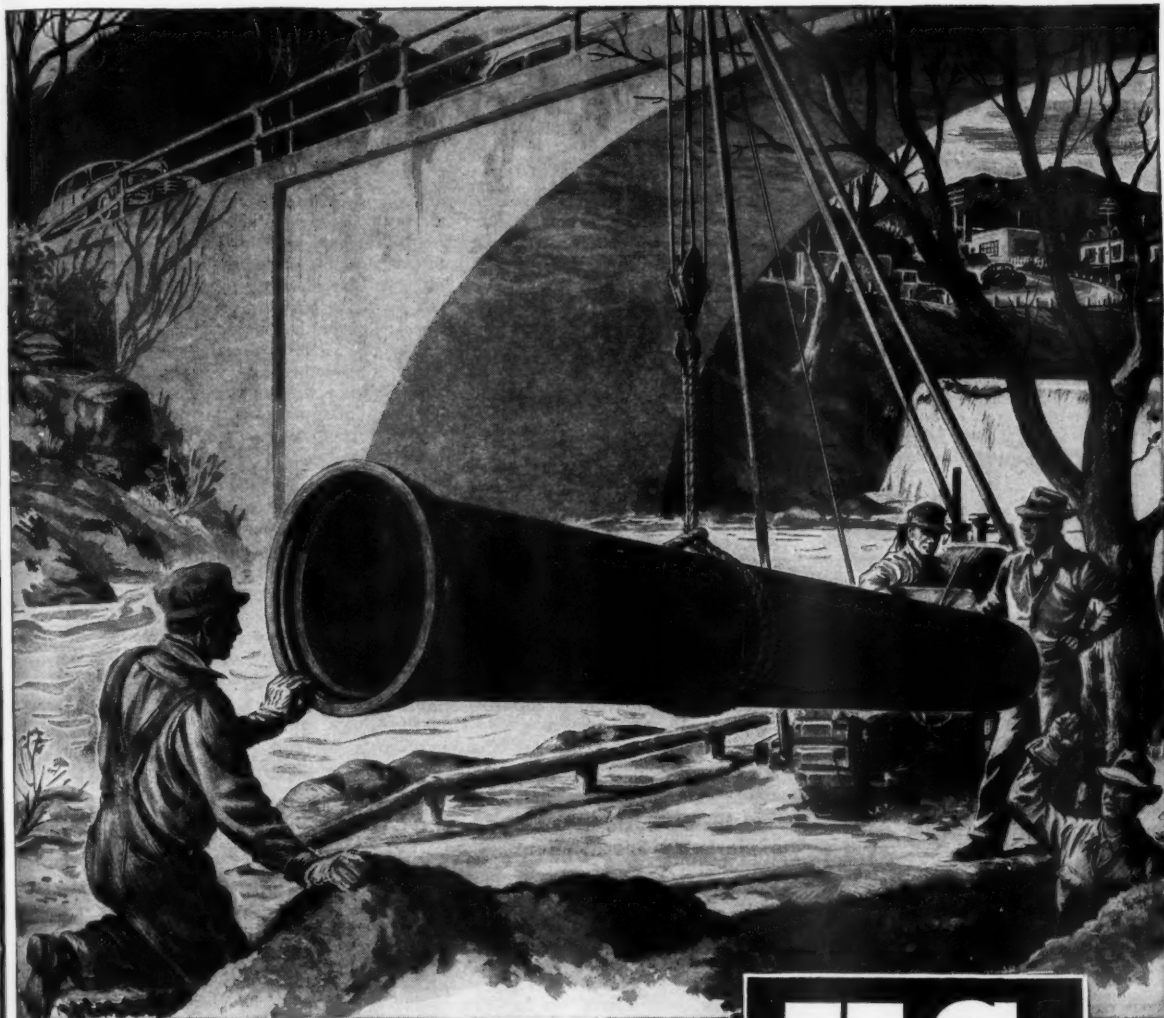


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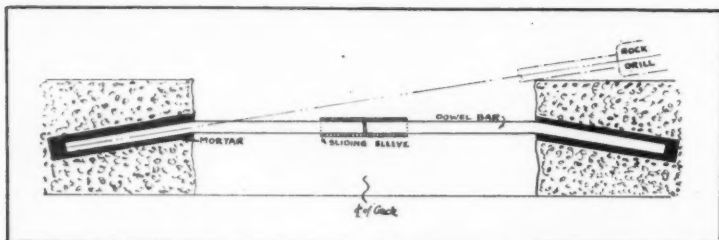
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The Highway and Airport Digest

Repairing Concrete Breaks

An English suggestion for repairing breaks in concrete roads is shown in the



Suggested method of dowelling cracked slab.

Courtesy Contractors Record

accompanying sketch. The essential feature is the drilling of sloping holes in opposite sides of the opening to permit the insertion of a bent dowel to tie the new concrete to the old. The hole is $1\frac{1}{2}$ " by about 9" deep. The sleeve is a short piece of steel water or steam pipe; or a screw coupling is used and the adjacent ends of the two bars threaded, one of them for twice the length of the coupling.¹⁴

Smoothing and Widening an Asphalt Road

A 15-mile section of 18-ft. asphalt pavement in Idaho which was rutted and rough and too narrow was recently leveled and widened to 20 ft. Instead of placing a leveling course to remove irregularities, the high points were cut off and the material so removed was pushed into a 4" x 12" trench at each edge of the pavement for the widening strip. The amount cut off varied from $\frac{1}{8}$ " to $\frac{1}{2}$ " in depth. A 6-ft. blade on a motor patrol was angled to cut $4\frac{1}{2}$ ft. width. Carried in front of it on the patrol was a pavement heater which softened the asphalt just enough to cut easily. The blade pushed the asphalt into the trench, and the rear wheel of the patrol was run over it to compact it; the trench later being filled to the top with plant mix material. The entire pavement was then covered with a seal coat, which corrected all remaining irregularities.¹⁴¹

Tar-Soil Stabilized Bases

The Committee on Tar Stabilized Roads of the ARBA, after studying the available data concerning such roads, especially in the south, has learned that those constructed with sandy soils had given satisfactory and economical service for periods up to 12 years, but those using clay soils were much less satisfactory. They be-

lieve that satisfactory results can be expected if the plasticity index of the soil does not exceed 15, the mica content 5%, and the clay-silt content (passing the 200 mesh sieve) 50%.

In some cases, soils not meeting these requirements can be made to do so with the addition of sand. Tests of the soil for these requirements are simple and easily made. There is no standard test for mica content, but if a microscopic examination shows no mica no further test is necessary.¹⁴²

Reducing Costs by Improving Specifications

It is believed that it is possible to reduce costs in highway construction by changes in specifications which will not affect the quality of the work. Members of a Joint Cooperative Committee of the A.A.S.H.O. and the A.G.C. have agreed on five standards which could be followed nationally in revising and modernizing specifications:

1. The documents should be definite enough to clearly set forth the details and character of the construction; yet they should be capable of flexibility in interpretation and application in order not to work a hardship on the contractor.
2. They should specify results, not methods. Phrases such as "or as the engineer may direct" should be eliminated wherever possible.
3. All refinements, especially hand labor, which add cost but contribute

nothing to the utility of the construction, should be eliminated.

4. Standardization of many materials and some details of design should be effected, particularly in states having similar climatic, geographic, and other conditions.

5. Payments to the contractor should be liberalized so that his capital will not be completely tied up, hampering his operations.

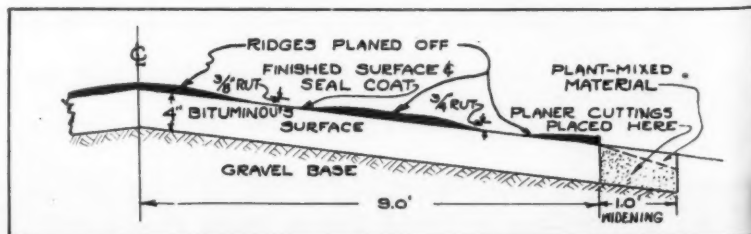
In No. 2, it is suggested that "in a manner approved by the engineer" be substituted, where some such provision is necessary. In 3 would be included hand rubbing of concrete, fine grading, and tolerances too limited to permit use of economical machine work, tolerances in moisture content in fill compaction, etc.

Under 4, specific items that could be standardized to afford greater efficiency and economy are:

1. Wire mesh. It has been reported that 23 different types of wire mesh have been specified by the various highway departments throughout the country.
2. Culverts, bridges and other structures. Standardization in this category would save substantial time and expense by permitting reuse of forms from job to job.
3. Curbing, handrails and guard rails.
4. Terminology of specifications; requirements and basic sizes and weights, compatible with regional conditions.¹⁴¹

Rapid Pavement Laying

With a single crew, Koss Construction Co. of Des Moines, Ia., laid 457,000 sq. yd. of concrete between March 11 and November 5, 1947, on four contracts in Missouri and Iowa. The best sustained production was 8 miles of 20 ft. slab in less than 30 calendar days. The equipment included 12 batch trucks, a subgrader, two 34 E pavers, concrete spreader, two finishing machines, four motor patrols and two bulldozers; a flatbed truck with winch and small derrick for handling forms.¹⁴⁴



How 18-ft. pavement was widened to 20 ft.

Courtesy Roads & Streets

In North Carolina, Rea Construction Co. laid in a 12-hr. day 2300 ft. of 8" x 22 ft. concrete pavement. During four 6-day weeks the average per day was over 2000 ft. In Indiana, one firm laid 52,656 sq. yd. of 9-7-9 concrete in one month; another firm 40,650 sq. yd., and a third laid 56,461 sq. yd.; and a fourth laid 36,380 sq. yd. in 15 calendar days.

In a Missouri grading contract, 3 Le Tourneau scrapers and 2 Tournapulls averaged 450 cu. yd. per hour on 10-hr. shifts. At the San Francisco Airport, the contractor hauled 5,086,000 cu. yd. 4 to 5 miles in 7½ months, working two 8-hr. shifts five days a week; the best one-day record being 42,800 cu. yd.^{N35}

Cost-Plus

Contract Items

"Misunderstanding of cost plus items in construction contracts produces more arguments and causes more ill feeling between the owner, the engineer and the contractor than do all other factors added together." Therefore every effort should be made to minimize such items. To cover any that may be unavoidable, the specifications should include a clear statement of conditions showing when cost plus items apply; an adequate description of the cost factors to be included under these items; and a positive definite statement of the method of computing payment for these items.^{N35}

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March-April

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X Traffic Quarterly

April

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- Proposed for Cities. By Pierre Zannettos. Pp. 128-151.
5. Traffic Factors in Bridge Planning. By M. Earl Campbell. Pp. 152-162.
- Y Contractors Record (England) April 28
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Highway Information

125-HP Rubber Tired Tractor.—This is described by its makers as the world's largest rubber-tired tractor. There are six speed and power ranges, giving speeds from 2.08 to 37 mph. It is fully described, with specifications, in a booklet available from the M-R-S Mfg. Co., Flora, Miss.

Gratings.—This catalog illustrates and explains the uses of all types of riveted and welded open steel and aluminum flooring, grating, stair treads, catwalks and structural steel walkways. Copy on request from E. C. Whitney, W. F. Klemp Co., 6639 S. Melvina Ave., Chicago 38, Ill.

Cinder Spreader.—The Baughman spreader is described in a 4-page folder illustrating (1) the material heater for cold weather spreading; and (2) the many uses and mechanical advantages of this spreader. Baughman Mfg. Co., Jerseyville, Ill.

A Big Crawler.—This is an excellent book technically, and just as good in layout and printing. It tell by "picture

story" the working functions of the TD-24 tractor. Duo-tone action photographs help tell what you want to know about this 180-hp. diesel crawler. Write International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.

Soil Stabilization.—A 23-page catalog tells about mixing for bituminous construction and soil stabilization; also brush and root removal, getting high densities in earth fills; clearing ice from streets; and many other uses. Seaman Motors, Inc., 298 North 25th St., Milwaukee 3, Wisc.

Lightweight Centrifugal Pumps.—This 4-page bulletin describes the characteristics, performance and uses of the new Gorman-Rupp lightweight centrifugal self-priming pumps, 1½, 2 and 3-inch. Ask for Bull. 7LW-13, Gorman-Rupp Co., Mansfield, Ohio.

A Special Rock Drill.—A 4-page bulletin describes the Cleco self-rotating, light weight (9 lbs.) hand held pneumatic drill that is convertible to a chipping hammer by removal of one part. Bulletin HD-1147, Cleco Division, Box 2119, Houston, Texas.

Snow Plows and Crushers.—The SnoMaster rotary snow plow, for heavy-duty work; the Model "F" 25-cu. ft. portable asphalt plant; the "Hammermill" crushing and screening plant; and a complete line of crushers are described in bulletins issued by Iowa Mfg. Co., Cedar Rapids, Iowa.

Subgrade Soil Practices

(Continued from page 27)

tended throughout the shoulders. In some cases an impervious top is placed upon the shoulders.

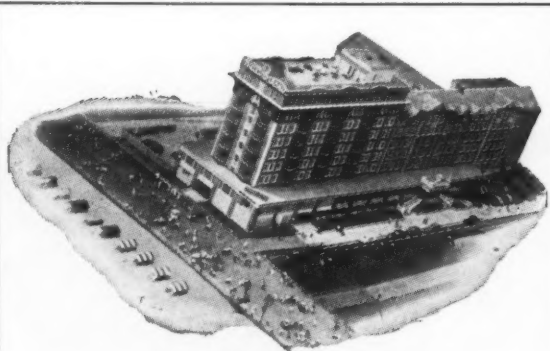
Subgrade Drain Backfill Requirements

Grading requirements for backfill material around drains is an item to which highway engineers have given increased attention in recent years. The replies indicated a wide range in requirements by the various departments; however, the specifications reflected the fact that considerable thought has been given to this item. It appears that findings of the U. S. Waterways Experiment Station² have played an important part in a more careful consideration of filter requirements.

Twenty-three states use French drains and a few others use them only occasionally. In most cases grading requirements are the same as for backfill material around subgrade drains. It is believed that

(Please turn to page 71)

²"Investigation of Filter Requirements for Underdrains." Technical Memorandum No. 183-1, U. S. Waterways Experiment Station, Vicksburg, Miss., 1941.



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present practices are a big advancement over those prevalent a few years ago of using large one-size aggregates which soon became clogged and ineffective.

Strength or Stability Tests

None of the state highway departments perform field load-bearing tests on rigid pavement subgrades for design purposes. Wisconsin stated that bearing values of soils depend upon moisture content which varies with meteorological conditions not only between seasons but between the same seasons in different years. They further stated that field bearing tests at any time are apt to be misleading and that rigid pavement performance depends to a greater extent upon uniformity of bearing power rather than upon its specific value.

Laboratory strength or stability tests on subgrade soils for rigid pavements are performed by 21 states. Thirteen of these report the use of the California Bearing Ratio test, while others use a modification of this test, shear, unconfined compression or triaxial tests. Fifteen states indicated that these tests are used as a basis for the design of rigid pavements; however, most

states did not give minimum design requirements. Some stated that the tests are used as a check only. Others reported that a standard thickness

of pavement is used and that where necessary the subgrade is reinforced to bring it to the proper supporting value for the thickness employed.

Small Sewage Treatment Plants

(Continued from page 29)

partment, which is utilized in transferring the mixed liquor to the final settling compartments. Each settling compartment is provided with an adjustable loading funnel. The wave action at the aeration tank surface carries mixed liquor into the loading funnel and to the stilling well in the settling compartment, where the sludge settles to the bottom. The circular motion of the contents of the aeration compartment draws the settled solids back into the aeration compartment, and the clear supernatant liquor is discharged to the effluent sewer.

The successful operation of any activated sludge plant is dependent upon the maintenance of the proper suspended solids concentration in the aeration tank mixed liquor. In the "Package Aerifier" plant, this concentration generally ranges between 800 and 1,200 ppm. and is maintained through the medium of a fifth

adjustable loading funnel, connected directly to the primary settling tank. The wave action developed by the aerator provides the hydrostatic head required for returning the mixed liquor to the primary tank, where the excess activated sludge settles out with the raw solids and is sent to the digestion tank for ultimate disposal. The effluent weirs in the final settling compartments control the water level throughout the plant.

Sludge Digestion and Drying


Square, fixed roof, sludge digestion tanks are usually provided. These may be heated or unheated, as dictated by population and other local conditions. No mechanism is recommended for the unheated tanks, but the use of a scum breaking mechanism is advantageous in the case of a heated tank. Supernatant selector pipes are provided at two-foot intervals in the upper

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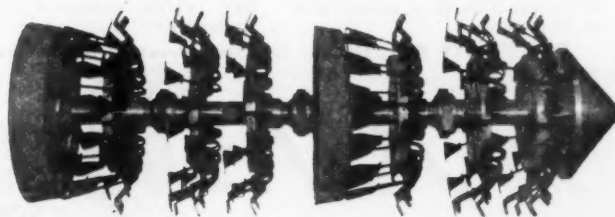
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reaches of the tank, together with an overflow which remains open at all times. Supernatant liquor is sampled in a control box on the tank roof, and the liquor is discharged to the incoming raw sewage.

Arrangement of sludge drying facilities are generally governed by local conditions. The beds should be enclosed by a concrete wall, be well drained, and the sludge bed drainage returned to the incoming raw sewage.

Operation

The "Package Aerifier" plant is simple to operate. Operational attendance resolves itself to daily visits for general clean-up, minor adjustments, lubrication and inspection of mechanical equipment, and simple routine tests. Reductions in BOD average 92% or more, and operating costs in terms of power consumed by the aerator average 0.2 kwh. per pound of BOD removed. Plants of this type are in operation in all sections of the country and in some foreign countries, climatic conditions having no particular effect. The plants are attractive, occupy very little space, and can be located in close proximity to dwellings without danger of odor or fly nuisance.

been satisfactorily solved. The first was frost. The excavating equipment is able to handle as much as a foot of frost without much difficulty. On unprotected ground in February about three feet of frost was encountered necessitating some extra work with air tools. The area to be used during the frost period will be insulated with leaves collected from streets in the fall, and little trouble is anticipated from frost.

Under conditions of high wind there has been occasional trouble with littering from papers blown off as the loads were being dumped. Some of this is inevitable and can only be met by hand policing. A portable wire fence placed on the leeward side of the dumping location has been quite effective in catching most of the paper and thus reduces the labor required for cleaning up.

The greatest difficulty encountered was with access to the dumping point for the collection trucks. There were two phases to this trouble, the first being the access road about one-fourth

mile long from the highway to the disposal site at the far end of the tract. An inadequate base permitted breakthroughs during spring thaws and in very wet weather. The fill operation has now been transferred to a point close to the highway, eliminating this phase of the trouble. As it is necessary to make use of more of the road in working farther in, rubble will be gradually added to make an adequate base.

The second aspect of the access problem is getting from the permanent roadway to the dumping point over the completed fill. This is a continuing problem inherent in the operation and is troublesome because it is necessary to travel over imperfectly-settled and unstable fill subject to thorough saturation from rains. Permanent substantial roadways are not practical for at least the last several yards because the dumping point is constantly being moved with the advance of the working face. The solution is the provision of a semi-permanent roadway paralleling the disposal trenches for full length and located at least a couple of trenches away from the one being filled, to make use of relatively stabilized fill and to give room for maneuvering. From this roadway the trucks must back across the fill. For this movement we propose providing movable mats, to be positioned by the operating equipment as required. Airplane landing mats of the pierced-steel plank type would be well-adapted but it has been impossible to secure any. Accordingly heavy plank mats or floats similar to those used with excavating machines are being made up from used lumber. Their use should eliminate most of the trouble from this source. In this connection it was found quite feasible, when the trucks could not readily reach the desired dumping point, to dump the loads some distance away and move the waste material from there to the disposal point with the bull-clam.

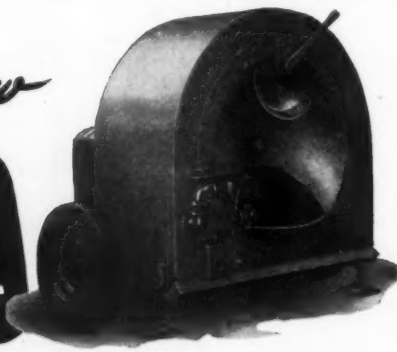
As a general observation it may be stated that the Winnetka experience only further demonstrates the importance of "good housekeeping" for satisfactory results with the sanitary fill for refuse disposal as well as for all other phases of the refuse problem. The best-conceived and equipped operation could become a serious nuisance and health hazard through careless, incompetent or indifferent personnel.

Operating a Sanitary Fill

(Continued from page 25)

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BOOKS and BOOKLETS

"Directory of Engineering Data Sources" is a new reference guide developed exclusively for the engineering profession. It is intended for use by design engineers. A fuller review of this text will be published in an early edition. It is available from Southeastern Research Institute, Inc., 5009 Peachtree Road, Atlanta, Ga.

"Industrial and Municipal Water" is the title of a booklet available from Ranney Method Water Supplies, Inc., Columbus, Ohio. This is an excellent technical publication and contains a good deal of valuable information on ground waters.

"Bituminous Mixing Plants" is a 36-page publication describing, primarily, the mixing equipment produced by Iowa Mfg. Co., Cedar Rapids, Ia. Secondly it contains a good deal of valuable material for the highway engineer, including a two-page glossary of bituminous terms and a similar section on the advantages of batch-type mixing.

Communicable Disease Control

This is the second edition of a book by Gaylord Anderson and Margaret Arnstein, which has been published by Macmillan Co., N. Y. We had the pleasure of working closely for several years, during the recent war, with Dr. Anderson, and we rate him at the top for knowledge of his subject, ability to write in understandable language, appreciation of the part that other than medical skills must play in communicable disease control, fairness, and the solid foundation of common sense that he not only possesses, but uses. His book must be good, and we are glad to recommend it fully without seeing this latest edition.

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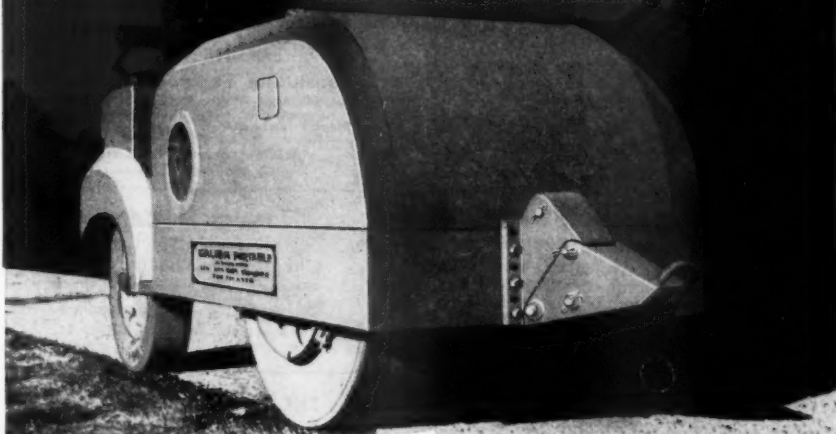
Galion Iron Works & Mfg. Co., Galion, O., a new 8-page catalog on the 3-5 ton tandem roller, designed for small construction jobs, driveways, road widening and resurfacing, and all kinds of maintenance work.

Water, Sewage and Industrial Waste Research

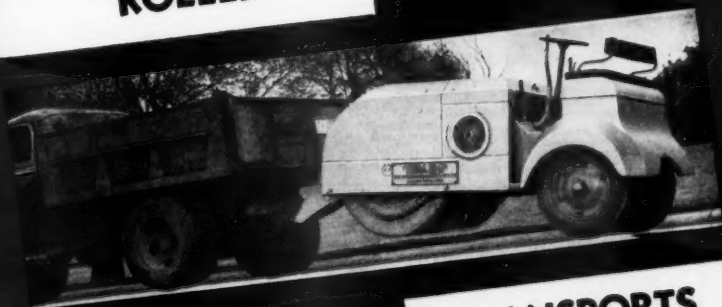
The Public Health Service will hold, at its Cincinnati Station, June 14 and 15, a program on research progress in the field of water, sewage and industrial waste. This is sponsored by the Sanitation Study Section of the National Institute of Health. It will bring together many of the foremost men in this field, and will cover a wide variety of work. The program arrived too late for inclusion in full in this issue. Full information and hotel reservations may be obtained from C. C. Ruchhoft, U. S. P. H. S., East Third and Kilgour Sts., Cincinnati 2, Ohio.

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PUBLIC WORKS Equipment News



Allis-Chalmers BD50 motor grader.

Allis-Chalmers New BD Motor Grader

The new BD50 hp. motor grader uses the standard A-C tubular frame design and provides full adjustment of the blade from the operator's platform, facilitating bank cutting, handling of big windrows, wasting dirt up banks and similar work. It has a GM 2-cycle diesel engine. There are six forward speeds, 1.30 to 14.69 mph., and three reverse, 1.55 to 5.41. For use under soft soil conditions, large front tires are available. *Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wisc.*, will send on request Folder MS-607 which contains full details on this new unit.

A Light and Useful Tractor

Here is a light riding tractor available for a wide variety of work in a municipality. It will operate at 1½ to 4 mph.; weight empty is just over 400



Power dump cart, snow plow, lawn mower and cultivator can be attached.

lbs. Attachments include snow plow, lawn mower and a transportation dump cart that can carry 800 pounds. The operator rides on the tractor.

Wheel base is 4 ft., and both forward and reverse speeds are provided. *Garden King Tractor Sales Co., Inc., Stratford, Conn.*, will send information on this handy unit.

A Truck for Extra Heavy Duty

The Milford special service truck embodies several unique design features. The limitations of a single front axle are overcome by a duplex front axle



Milford special service truck.

system in which a steering linkage provides the correct ratio of steering angle between the two axles and the load is divided equally on the axles. These trucks are particularly adapted for the mounting of winches and cranes. The

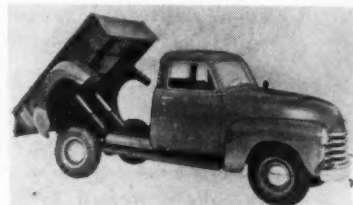


6-yd. Bucyrus-Erie cable controlled scraper.

"dual-service" cab contains special winch controls, centered behind the driver where they can be reached easily. The Milford truck is available in two sizes, 33,000 and 48,000 lbs. Further details from *Milford Crane and Machine Co., Milford, Conn.*

Hydraulic Hoist and Body for Pickup Trucks

These fully automatic, hydraulically operated, cab-controlled, twin hoists and dump bodies are available for nearly all makes and models of ¾- and 1-ton trucks. Control is by a fingertip lever in



Twin hoist dump by National Equipment Co.

the cab, hand pumping being avoided, thus speeding up the work. The tailgate swings from either top or bottom, according to the operator's desires. There are many other time and labor saving features. *National Truck Equipment Co., Dept. 514, Waukesha, Wisc.*

4-Wheel Scrapers, 4 to 10 Cu. Yds.

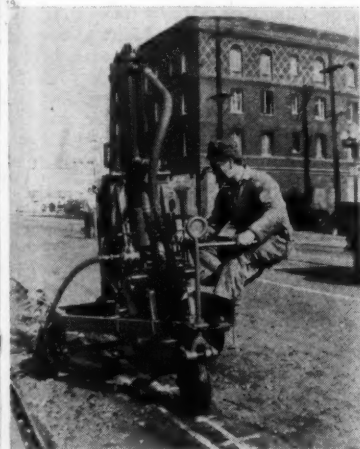
These new cable controlled four-wheel scrapers have many advantages in dirt-moving. They are available in four sizes, with struck capacities of 4, 6, 8, and 10 cu. yds. Technical data may be obtained from *Bucyrus-Erie Co., So. Milwaukee, Wisc.*, and the scrapers will be shown by B-E and IHC at the Road Show.

Universal to Make Small Concrete Pipe

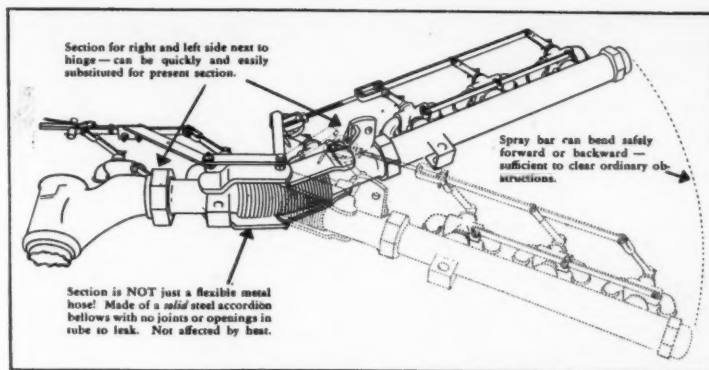
The Rochester, N. Y., plant of the Universal Concrete Pipe Co., has announced that it will manufacture small size concrete pipe—4" through 12". This pipe will be made on a spinner-type machine.

Small and Powerful Paving Breaker

A paving breaker mounted on a tricycle running gear, driven by an



This takes some of the hard work out of pavement breaking.



Etnyre distributor spray bar section.

air motor, and capable of moving up a 15° incline, will break concrete up to 10" thick and will tamp backfill. In its initial tests, it broke 900 sq. ft. of 4" concrete pavement per hour. One man operates the machine which is driven by one 105 cfm. compressor. It will operate below ground level to a distance of 30". For fuller information, write R.P.B. Corp., 2751 East 11th St., Los Angeles, Calif.

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A "relieving section" for circulating spray bars of bituminous distributors permits the bar to bend either forward

or backward sufficient to clear any ordinary obstruction without bending or damaging the bar. This can be quickly and easily substituted on present bars. Hitting bridges, tree stumps, posts and other roadside obstructions is no longer a major catastrophe. For full information on this, write E. D. Etnyre & Co., Oregon, Ill.

An Insulated Crackfiller

For use with rubber compound materials, this Model A crackfiller has 1" of insulation, giving a thermos jug effect. Materials are held at practically a constant temperature. There are 2 nozzles and the capacity is 1½ gals.

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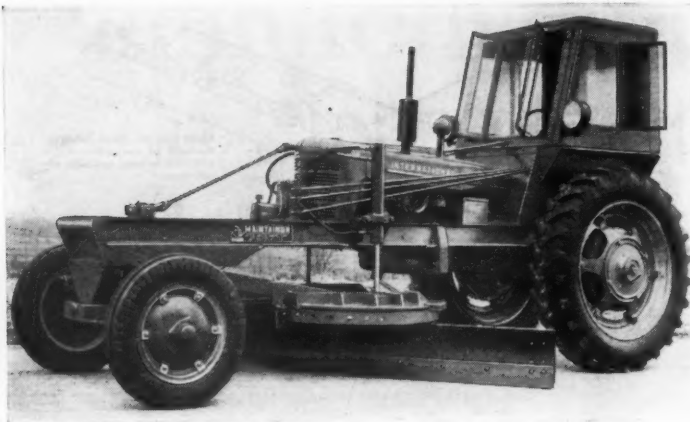
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WRITE FOR DETAILS

THE GOLDAK COMPANY

1544 West Glenoaks Blvd., Glendale 1 California





The Meili-Blumberg power maintainer.

The Model B is the same overall size and shape, but does not have insulation. Capacity is 3 gals. These units can be used for crackfilling and patching work. *Butler Industries, Inc., 6450 LeGrand Ave., Detroit, Mich.*

Handy Hydraulically Controlled Power Maintainer

This is a power maintainer built around a modified 31.5-hp. International power unit. It is designed for maintaining highway berms and secondary roads; for maintaining streets and

alleys; and for construction and maintenance work by small contractors. It can be used with a power broom, V snow plow, bulldozer blade and scarifier. Five speeds give a range of 2.5 to 15.7 mph. The blade clearance is 12" and maximum blade pressure, 5,000 lbs. *Meili-Blumberg Corp., New Holstein, Wisc.*

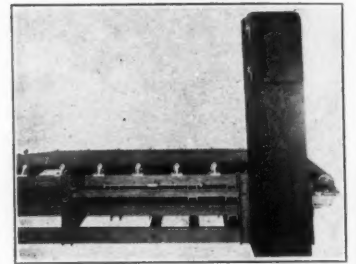
Shovel and Dragline Yardage Estimator

Thew Shovel Co., Lorain, O., has developed a slide rule 9" long which can be used for a quick determination

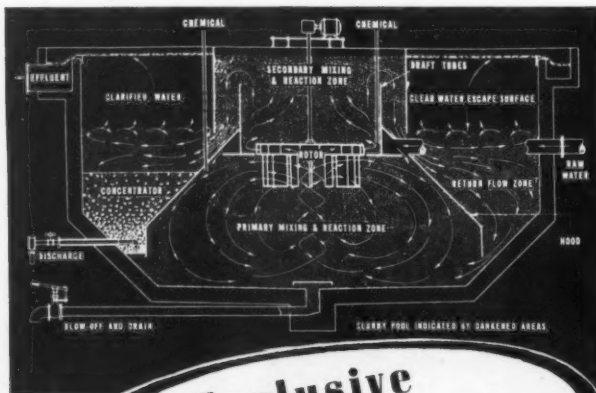
of the approximate yardage per hour for various sizes of shovels and draglines. Conversions can be made for size of machine, type of material, degree of swing, bank height and various job and management conditions. For yours, write Lee Judge, 1404 Terminal Tower, Cleveland, Ohio.

Simplified Meter and Conveyor

By utilizing a diaphragm to transmit load changes instead of the usual knife-edge-beam principle the Builders-Providence Conveyoflo Meter eliminates bulky overhead framework, scale beams, knife edges, tie rods, etc. As a result the unit is simple and occupies little space. The Conveyoflo Meter may be used to proportion and control dry materials as well as weigh them, and



Builders meter-conveyor.



Exclusive Rotor Circulator with the ACCELATOR

The rotor circulator makes possible the exclusive operating principle of the ACCELATOR* which effects a "dynamic separation" of treated water from a directed flow of slurry. It has two parts on one shaft connected directly to a speed reducer.

The lower part thoroughly mixes the incoming raw water and treating chemicals with the highly concentrated slurry in the primary mixing zone. It turns over the contents every minute and prevents settling.

The upper part produces the exclusive slurry circulation with the positive return of solids from the separation zone to the primary mixing zone.

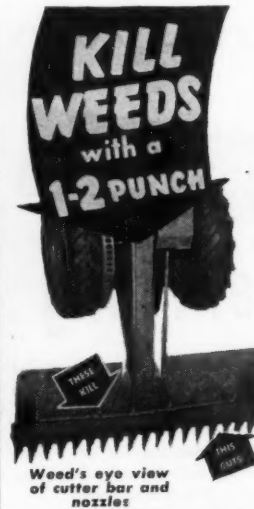
All motions in the ACCELATOR are independent of the treating rate. The mixing and positive recirculation are the same with high or low throughput. The surface of the slurry pool remains substantially at a constant level.

Ask for information on other exclusive features of the ACCELATOR. INFILCO Inc., 325 West 25th Place, Chicago, Illinois.

*Trade-Mark Reg. U. S. Pat. Off.



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This new machine gives your weeds a double knock-out blow by cutting them and then spraying them in one operation. Four spray nozzles, directly behind the cutter bar, spray chemical right down the center of freshly cut plants. Special shields on trailing edge of cutter bar eliminate spray drift and keep cut weeds off ground until spray is applied.

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can control the flow of liquids in proportion to the flow of dry materials. Load changes are transmitted hydraulically to the weighing mechanism which is automatically corrected for any belt speed variation. Compensation is also made, through a system of return belt weighing, for variations in belt weight and adherence of material to the belt. Full data from *Builders Providence, Inc., 16 Codding St., Providence, R. I.*

Huber Demonstration Trucks

Huber Mfg. Co., Marion, Ohio, has sent out on the road two demonstration trucks carrying the Huber Maintainer with lift loader and bulldozer auxiliaries and towing a 3-4 ton Huber tandem roller. To date demonstrations have included: Maintenance of roads and streets; back-filling with the bulldozer; street grading; clearing rubbish with the lift-loader; using the lift-loader on stock-pile operations; skinning topsoil; and rolling asphalt.

A Powerench to Speed Valve Opening

For keeping gate valves in good operating condition and for emergency shut-offs, this power wrench will be most valuable to any municipality. It has ample power to operate valves; it can open or shut them; it has a revolution counter which registers the turns



Huber puts its demonstration unit in the field.

made by the gate key. It is also valuable for many other types of work, such as operating sluice gates, drilling timber and digging post holes; and it will also operate pipe cutting and tapping machines. *Payne Dean & Co., Madison, Conn.*

Increased Tractor Horsepower Ratings

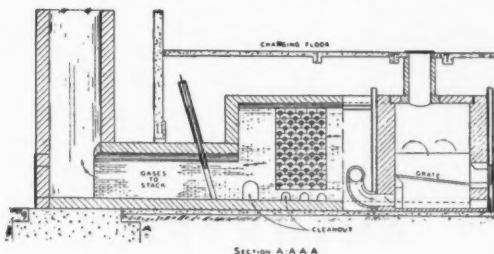
International Harvester Co., Chicago, has announced increased horsepower ratings for the TD-14 and TD-18 tractors. The TD-14 diesel crawler tractor now develops 72 hp. at the flywheel, 68 belt hp. and 57 drawbar hp. at 1400 rpm. The TD-18, also a diesel

crawler tractor develops at 1,300 rpm. 97 hp. at the flywheel, 91.5 belt hp. and 80.5 drawbar hp.

Electrolytic Floc Producer for Water Purification

The principle of electrolytic dissolution of aluminum in water to form concentrated aluminum hydroxide floc is used in the new Alhydro Floc Producer. A low voltage electric current, applied to an assembly of alternate aluminum and stainless steel plates, releases free particles of aluminum which immediately react with water to form a concentrated floc. The plate assembly is housed in a rubber lined stainless steel tank,

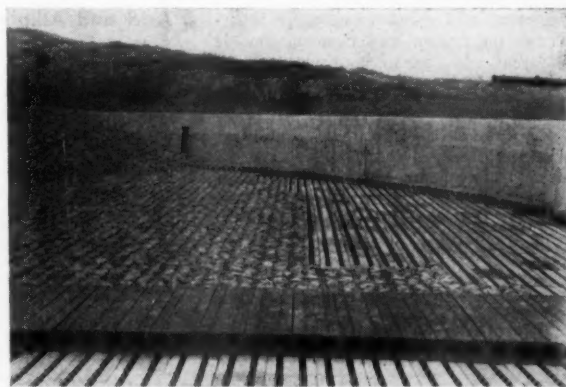
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through which a constant flow of water is maintained. Floc production is controlled by variation of the electric current. As the aluminum is converted into floc the plates are gradually used up. Replacements are made without special tools or equipment. It is said that 68 lbs. of aluminum do the work of nearly $\frac{3}{4}$ of a ton of other coagulants. Full details of this unit from *Alhydro, Inc.*, 516 N. Charles St., Baltimore 1, Md.

Heavy Duty FWD Truck, Model ZU

This new truck is rated at 33,000 lbs. gross vehicle weight. It has 4-wheel

drive, with a 188 hp. engine. The cab is entirely of steel. The manufacturer recommends this truck for highway departments' for all-year maintenance, with special emphasis on heavy-duty snow removal.

Eastern Tractor Buys Eddy Plow

The Eastern Tractor Mfg. Co., Kingston, N. Y., has purchased the Eddy Plow Works of Greenwich, N. Y. The acquisition will permit Eastern to manufacture the implements for its tractors formerly purchased from others.

How to Do a Better Job

Jointing for Water Mains.—This is a good text on how to make good water pipe joints. It takes some of the mystery out of the business and tells in plain language how BOND-O is made, where and how it should be used, and the kind of service it will produce. Specially good features are the sections dealing with wet joints, pipe lines under water, pipe lines without water pressure, use with split sleeves, and practice on bridge or under-railroad jobs. Write Guy Northrop, Northrop & Co., Spring Valley, N. Y., for a copy.

Crib Walls.—If you have retaining walls to construct and want to know how crib walls may be used, write for this booklet. It tells where and why to use them, and contains valuable information on design and construction. It is a real addition to your engineering library. Universal Concrete Pipe Co., Columbus, Ohio.

Perforated Materials.—If you want plain or funny-shaped holes in metal sheets, name your hole and the kind of metal and you will find it in this catalog. We never knew there were so many shapes of holes available. Ask for Catalog 62, Harrington & King Perforating Co., 5655 Fillmore St., Chicago 44, Ill. The book contains lots of handy tables, too.

Water Conditioning.—This relates mostly to swimming pool installation—considerations in planning, standard dimensions, essentials of a recirculation system, and descriptions of approved equipment for purification of the water. There are many drawings and illustrations. Liquid Conditioning Corp., Dept. PU, 114 East Price St., Linden, N. J.

Centrifugal and Rotary Blowers:

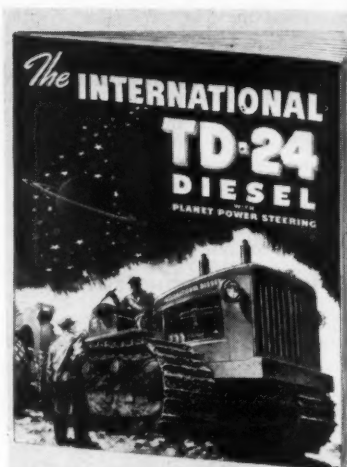
Roots-Connersville Blower Corp., Connersville, Ind., Bulletin G-82, describing and illustrating its blowers and exhausters, positive displacement meters, rotary liquid and vacuum pumps, and inert gas generators.

Acid and Alkali-Proof Coatings:

Nukem Products Corp., Buffalo 20, N. Y., Bulletin 24 on acid and alkali resistant resin coatings, Bulletin 35 on resistant tank linings, and Bulletin 40 on acid and alkali proof resin coatings.

Duct Rodding Equipment:

Flexible Sewer-Rod Equipment Co., 9059 Venice Blvd., Los Angeles 34, Calif., a 4-page folder showing the application of its equipment in conduit work, including the use of spear heads, augers, corkscrews, pilots, duct fishers and pullouts.



This catalog describes the big 180-hp. IHC tractor.

Films and Photo Contests Contests

A sound motion picture shows how the P & H single pass soil stabilizer works. This is 16mm. and runs 22 minutes. Suitable for highway, street, airport and contractor personnel. Available without cost. Write Harnischfeger Corp., Milwaukee, Wisc., giving date picture is desired.

"Material on the Move" is a 16mm. color and sound movie showing the application of scrapers for earthmoving. Copies are available through Caterpillar Tractor Co., Peoria, Ill., or any of its distributors.

A 1948 catalog of technical books, covering chemistry, technology, engineering, metals, etc., has been issued by Chemical Publishing Co., 26 Court St., Brooklyn 2, N. Y. Sent free.

Ford Meter Box Co., Wabash, Ind., desires photographs showing their products in use or being installed for use in a forthcoming catalog. For every photograph used, they will pay \$5 plus a billfold; for best pictures of each product they will pay \$10; and for the best single picture, \$50.

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NEW LISTINGS

Time for a New Transit Level?

1. Two are described in attractive illustrated folders. One, the Warren-Knight, is "used like a transit, checked like a level." Another, the Sterling Convertible Level. Investigate free trial offer. Use coupon or address Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

"Dozing" the Way

3. A 16-page bulletin showing how bulldozers are used on various kinds of construction—levees, dikes, canals, road construction, maintenance and stump removal. Form 10360 is well illustrated. Caterpillar Tractor Co., Peoria 8, Ill.

Handling Ready Mixed Concrete

5. A new pamphlet illustrates the uses of Dumperette bodies for handling air-entrained concrete without agitation. Action pictures show use under various conditions. Ask for your copy from Maxon Construction Co., Inc., 131 N. Ludlow St., Dayton 2, Ohio.

The Toughest Steel

7. A 48-page construction bulletin shows the application of manganese steel to tractors, loaders, buckets, bull-dozer, scarifiers, mixers, rope sheaves, pumps, etc. American Manganese Steel Co., Chicago Heights, Ill.

Long Distance Recording of Level-Pressure-Flow

9. Be sure to get Bulletin 358 on the "Chronoflo Telemeter" that brings accurate records of flow, level, pressure, temperature, gate positions, weight, etc., from widely scattered locations to a central operating point. Widely used in Water and Sewage plants. Write: Builders-Providence, Inc., 16 Codding St., Providence 1, R. I.

Reduce Your Mowing Time With a Power Mower

11. The Millner Master Mower is ideal for cutting the tallest grasses and weeds quickly and thoroughly. Will cut a 24 inch swath and cuts right up to trees, shrubs and fences. For complete information and the name of your nearest dealer write Millner Products Company, Dept. PW, Barnett-Madden Bldg., Jackson, Miss.

A New Answer to Some Old Waterworks Problems

12. That is what they call "Hypo-Chlorination of Water," a 75-page illustrated discussion of this live subject, in a booklet packed with helpful information. For your copy, address: Mathieson Chemical Corp., Dept. PW, 60 E. 42nd St., New York 17, N. Y.

All About Cement-Mortar Lining of Water Mains

13. Here, in a really beautiful booklet, is practically everything you need to know about this method of lining mains in place—the needs, methods, and results that will interest you. Centriline Corp., Dept. PW, 140 Cedar St., New York 6, N. Y.

How Elevated Water Tanks Can Save on Operating Costs

14. Beautiful new booklet on Horton elevated steel water tanks suggests ways to reduce pumping costs, increase capacity of systems, maintain uniform pressure, etc. Illustrates 7 models of welded, ellipsoidal-bottom, elevated steel tanks in full color. Write Chicago Bridge & Iron Co., 2115 McCormick Bldg., Chicago 4.

Hydraulic Dump Bodies For Every Purpose

15. There's a hydraulic hoist or dump body designed and built to fill your need. Hercules bodies are designed to do a specific job in less time and at a lower cost. Specifications and data on the complete Hercules line available without obligation by writing to Dept. PW, Hercules Steel Products Corp., Gallion, Ohio.

Road Protection at Less Cost

16. There's no limit to the jobs you can handle with an Allis-Chalmers Package outfit consisting of the HD-5 Tractor with Tracto-Shovel and Model A-D Motor Grader. For booklets describing and illustrating these and other Allis-Chalmers

Equipment write Dept. PW, Allis-Chalmers Tractor Division, Milwaukee 1, Wisc.

The Modern Way to Filter Swimming Pool Water

17. That's the title of a new bulletin full of facts about Bowser's new diatomite filter to produce clear, sparkling, clean water at low cost. Occupies small space, doesn't waste water. Gives sizes to use, performance charts, etc. Write Bowser, Inc., Dept. PW, Ft. Wayne, Ind.

Latest Facts on Marlow Pumps for Utility Use

18. Attractive new booklet U-47 tells all about Marlow centrifugal utility pumps in 1", 2" and 3" sizes. Gives test performance data. Featherweight aluminum units. If you are also interested in larger pumps, ask for G-47 too. Marlow Pumps, Dept. PW, Ridgewood, N. J.

Sewage Plant Gas Storage Facilities

19. General information on estimating figures on Hortonspheres to store surplus gas produced in digesters at sewage disposal plants supplied by Chicago Bridge & Iron Company, 2115 McCormick Bldg., Chicago 4, Ill. Hortonspheres are built in sizes up to 65 ft. diameter for pressures as high as 60 pounds per sq. in. for storage at sewage plants utilizing digester gas.

Equipment for Treating Sewage, Water and Trade Wastes

20. A well prepared 44 page illustrated booklet on use and advantages of Flocculators, Traveling Water Screens, Triturators, Sludge Collectors, Sludge Removers, Grit Collectors and Bar Screens made under the name of "Rex" for use in Trade Wastes, Sewage and Water Treatment by Chain Belt Company, 1722 West Bruce St., Milwaukee 4, Wisc. Contains a page of useful Conversion Factors.

CONSTRUCTION AND MAINTENANCE

Data Book on Universal Concrete Cribbing

21. Shows typical sections for designing walls, pictures many applications, specifications, etc. Get the facts today about this economical reinforced concrete cribbing. Universal Concrete Pipe Co., Dept. PW, 297 So. High St., Columbus 15, Ohio.

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Strong, Speedy, Low-Cost Maintainer Has Many Uses

22. BG Maintainer, a powerful speedy, low-priced machine for light road maintenance. Full details in illustrated folder. Huber Mfg. Co., Dept. PW., Marion, Ohio.

Won't a Small Tractor Help You?

23. If your problem calls for a snow plow-grader or a power mower, Gardena Tractors provide an efficient, economical solution. For full data, write Dept. PW., Eastern Tractor Mfg. Corp., Kingston, N. Y.

Useful Attachments For Your Industrial Tractor

24. Need a front end bucket loader that can be converted into a light plow or grader in a matter of minutes? Write for this folder that illustrates, describes and gives specifications of the Ottawa Industrial Front End Loader for industrial tractors. Loads earth, sand, gravel and other bulk material. Quick change over can be made to light bulldozer, V-type snow plow, grader or maintainer with attachments. Write Dept. PW., Ottawa Steel Products, Inc., Ottawa, Kans.

One to Two H.P. Air Cooled Engine for Dependable Power

25. New bulletin, illustrates many uses for Clinton 1 to 2 H.P. gasoline engines. Gives full specifications and power data. An economical, long lasting power unit. Write Dept. PW., Clinton Machine Co., Clinton, Mich.

Two-Way FM Radio Telephone Equipment for All Departments

26. For booklet describing and illustrating the Motorola Two-Way Radio Telephone or for specific recommendations concerning your application write to Dept. PW., Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.

Diesel Engines to Help You Build Profits

27. A new 28 page catalog just off the press titled "Superior Stationary Diesel Engines," is packed with facts that will help you build profits. For your copy write to Superior Engine Division, National Supply Company, Springfield, Ohio.

Solve Your Drainage Problems This Easy, Permanent Way

28. Useful new 60 page catalog on standard corrugated pipe, multi-plate pipe and arches and 18 other drainage and related products for culverts, sewers, sub-drains, flood control, airports, water supply and other types of construction. Ask for "Armco Products for Engineering Construction." Armco Drainage and Metal Products, Inc., Dept. PW., Middletown, Ohio.

Levels Sidewalks and Curbs Quickly and Easily

29. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 W. Concordia Ave., Milwaukee 10, Wis.

Methods of Installing Steel Sheet Piling

30. Illustrated descriptions of both standard and interlock corrugated steel sheet piling of minimum weight, maxi-

mum strength, ease of handling with methods of installation are contained in a booklet. If you have a job involving piling write Caine Steel Co., Dept. PW, 1820 No. Central Ave., Chicago 30, Ill.

Speed Maintenance With This Portable Air Compressor

31. LeRoi Portable compressors in sizes from 60 to 500 c.f.m., gasoline or Diesel powered on mountings to fit your special needs. Same manufacturer makes both compressor and engine. Complete bulletin. Write LeRoi Company, 1770 So. 68th St., Milwaukee 14, Wis.

SEWAGE DISPOSAL

One-Unit and Two-Unit Vitrified Floor Systems

32. Metro one-unit and two-unit vitrified clay blocks for trickling filter floors are described in illustrated catalog. Includes construction drawings, pictures and complete specifications. Ask for your copy today. The Metropolitan Paving Brick Co., Canton, Ohio.

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

33. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Does Air Sabotage Your Pipe Lines and Pumps?

34. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simplex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Save Trucks and Labor In City Rubbish Collection

35. For saving trucks, labor, and time in city rubbish collection get details of the new Dumpster-Kolektor described in literature just published by Dempster Brothers, Inc., 996 Higgins, Knoxville 17, Tenn.

Packaged Sewage Treatment— Just Right for Small Places

36. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Do Your Water Mains Need Cleaning?

38. Literature on Flexible method of cleaning water mains any size from 2" to 72", giving full details and list of nearest representatives in all parts of country. Address: Flexible Underground Pipe Cleaning Co., 9059 Venice Blvd., Los Angeles, Calif.

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Valuable Booklet on Porous Diffuser Plates and Tubes

40. A valuable booklet on porous diffuser plates and tubes for sewage treatment plant. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20 pp., illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

Solve Corrosion Problems With This Special Alloy

41. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

Design Details for Sludge Collectors

42. Booklet No. P.W. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, illustration pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

All of These Booklets Are FREE, and Many Are of Great Value. To Order Those You Need in Your Work Use the Coupon on Page 81.

Ask for This Design Data On Sprinkling Filters

43. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

SNOW FIGHTING

For High-Speed Snow Removal

44. "Frink One-Way Sno-Plows" is a four-page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

STREETS AND HIGHWAYS

Protect Your Grade Crossings With Model 10 Signals

45. Bulletin G17-PW6 describes and illustrates the automatically operated Model 10 railroad crossing signal. Folder describing this signal which guards against "second train" accidents and permits fast flow of rail and highway traffic is available on request from Western Railroad Supply Co., 2406-2436 South Ashland Ave., Chicago 8, Ill.

Save Time and Labor by Using a "Black-Topper"

46. The Etnyre "Black-Topper" is a bituminous distributor that will save you time and labor on the job. For bulletin giving details of the accurate, dependable and economical performance of this distributor write Dept. P.W., E. D. Etnyre & Co., Oregon, Ill.

Data on All Types of Bins and Batching Plants

47. Good illustrations and useful data on all types of Heltzel Highway Bins, for truck mixer charging, bulk cement plants, enclosed bucket elevators, belt conveyors, etc. Heltzel Steel Form & Iron Co., Dept. P.W., Warren, O.

Speed Your Work With These Powerful Motor Graders

48. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Practical Portable Power Units for Every Need

49. M-M power units with heavy duty engine, positive lubrication, easy servicing, handy controls may be just what you have been looking for. Simple, durable, practical. Get latest bulletin from Dept. P.W., Minneapolis Moline Power Implement Co., Minneapolis 1, Minn.

Here's Your Diesel Tractor!

50. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Need Street, Sewer or Water Castings?

51. Street, sewer and water castings in various styles, sizes and weights. Manhole covers and steps, inlets and gratings, adjustable curb inlets, water meter covers.

cistern and coal hole covers, gutter crossing plates, valve and lamphole covers, etc. Described in catalog PW issued by South Bend Foundry Co., South Bend 23, Ind.

Latest Maintenance Equipment For Blacktop Roads

52. "Blacktop Road Maintenance and Construction Equipment". Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

WATER WORKS

Eliminate Taste and Odor From Your Water

53. Technical pub. No. P.W. 213 issued by Wallace & Tiernan Co., Inc., Newark 1, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination. Send free to any operator requesting it.

Simple Method of Underground Pipe Installation

54. For bulletin on simple method of underground pipe installation for distances up to 150 or 200 feet by boring with the Hydrauger write to Hydrauger Corp., Ltd., 681 Market Street, San Francisco 5, Calif.

Here's Data on All Swimming Pool Needs

55. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. P.W., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

Have You a Water Conditioning Problem?

56. Installation-tested equipment for complete municipal and industrial systems

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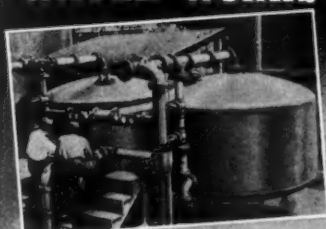


CHEMCO CHLORINATORS are available for every type of installation. The above shows two CHEMCO 100# capacity chlorinator installed for the State of New York. Note use of Aquo-Thermal Coils.

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or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

**Quick Way to
Locate Leaks and Pipe**

57. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

**To Measure, Mix, Feed
Chlorine or Other Gases**

58. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding chlorine or other gases in solution. Capacities range from 1/4 lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

**Hydraulic Pipeline Scraper
For Water and Sewage Mains**

59. For a copy of this compact folder on a hydraulic pipeline scraper which cleans all kinds of mains from 4 inches to 14 inches write to Dept. PW, Carver-Stimpson Pipe Cleaning Co., Walters, Okla.

**Chem-O-Feeders for
Automatic Chemical Feeding**

60. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation, treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioners, Inc. %, % Codding St., Providence 1, R. I.

**What You Should Know About
Meter Setting and Testing
Equipment**

61. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 40-page booklet P.W. You should have a copy. Ask: Ford Meter Box Co., Wabash, Ind.

Find Buried Pipe and Leaks

62. Finding Buried Pipe, Leaks is easy with the new Featherweight Goldak Pipe Locator. An easy-to-read illustrated bulletin tells the full story quickly. Address: The Goldak Co., 1544 W. Glenoaks Blvd., Glendale 1, Calif.

**All Kinds of Valves
And Hydrants**

63. Hydrants and Valves. Catalog P. W. covers fire protection appliances, including hydrants, gates and check valves. Catalog also describes sluice gates, shear gates, and flap, mud, gate, check and foot valves. Address: Mueller Company, Chattanooga, Tenn.

Helpful Data on Hydrants

64. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

**Find Your Leaks
In a Jiffy**

65. For tracing buried pipes and finding hidden leaks get details of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6 Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

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The Road Show

The 45th annual convention of the American Road Builders' Association and the International Road Show will be held at Soldier Field, Chicago, Ill., July 16 to 24. This will be the first Road Show in 8 years and also the first out-door show. This was necessary because the space requirements of the Show have grown beyond the capacity of indoor space available.

Practically every manufacturer of road-building and construction equipment will be represented at the Chicago exhibits, and much new and improved equipment based on war-time experiences and developments will be shown. The programs of the technical meetings have not yet reached us, but they are likely to be as up-to-date as the technical exhibits.

Florida Engineering Society

At its 32nd annual convention, held at Orlando, April 22-24, the Florida Engineering Society elected the following officers: President, Wylie Gillespie of Jacksonville; Vice presidents, A. P. Michaels of Orlando and E. A. Nordstrom of St. Petersburg; secretary, David B. Lee of Jacksonville; and treasurer Raymond Chase, also of Jacksonville. New directors are Earl Rader and R. A. Menendez.

Ohio Conference on Sewage Treatment

The 22nd annual conference will be held June 23-25 at the Dayton-Biltmore Hotel, Dayton, O. G. A. Hall, Secretary, State Health Dept., Columbus, O.

Jobs for Engineers

Two sanitary engineers are needed by the Louisiana State Department of Health for field work in that state. Salary is up to \$310 per month. Write John H. O'Neill, State Sanitary Engineer, c/o The Dep't of Health, New Orleans, La.

Engineer Available

A highly qualified man has just returned from China, where he administered the UNRRA sanitary engineering program there. He has had experience in state health work, design and construction of sanitary engineering facilities, and in other fields. He desires contacts in public health work, teaching or consulting engineering. Write to the Editor of this magazine, who will forward letters.

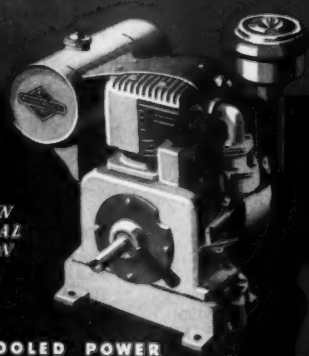
REQUEST FOR BIDS

The City of El Paso, Texas, will open bids May 11, 1948, for the main contract covering construction of its downtown track separation project. Estimated cost—\$2,000,000; construction of its downtown track separation—140,000 cu. yds. excavation; 14,000 cu. yds. concrete; 232,850 lbs. sheet steel piling; 200 tons of H-bearing piles, 640,000 lbs. reinforcing steel; 675,000 lbs. structural steel. Job expected to last about 2 years. DeLeuw, Cather & Co., Chicago, engineers. Public Works Engineer, El Paso, city official for information and correspondence.



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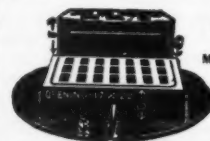


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